CHAPTER 6

INDUSTRY SCOPE AND SUBCATEGORIZATION

6.1 Introduction

This chapter discusses the scope and applicability of the proposed rule and the subcategorization analysis for the Industrial Laundries Point Source Category. The purpose of the scope and applicability is to define the type of facilities that will be covered by the proposed rule. The purpose of subcategorization is to group together, if appropriate, facilities of similar characteristics so that pretreatment standards representative of each group can be developed. This provides each subcategory with a uniform set of pretreatment standards that consider technological achievability and economic impacts unique to that subcategory.

After examining data collected on the industry, EPA has determined that subcategorization of the Industrial Laundries Point Source Category is not appropriate, as discussed in this chapter.

The following sections discuss the following topics:

- Section 6.2 discusses the regulatory background of the industrial laundries industry;
- Section 6.3 discusses the scope of the industry;
- Section 6.4 presents the subcategorization analysis; and
- Section 6.5 presents the references used.

6.2 Regulatory Background

As discussed in Chapter 2, the Auto and Other Laundries Category, of which industrial laundries was a subcategory, was mandated for study and possible effluent limitations guidelines and standards development by the 1976 Settlement Agreement. However, in 1982, the category, including the industrial laundries subcategory, was excluded from regulation. The industrial laundries subcategory was excluded because, based on assessments made at that time, it was determined that 95 percent of the industry discharged pollutants that could be treated by publicly owned treatment works (POTWs) and that did not pass through, interfere with, or otherwise prove incompatible with the operation of POTWs.

After gathering additional information about the industrial laundries industry, EPA published its 1986 Domestic Sewage Study (DSS), which identified industrial laundries as potential contributors of large amounts of hazardous pollutants to POTWs. In its 1990 Effluent Guidelines Plan (55 FR 80), EPA listed the industrial laundries industry as a new category to be studied for possible effluent limitations guidelines and standards development. The Natural Resources Defense Council (NRDC) and Public Citizen, Inc. filed suit against EPA, charging that EPA's plan did not meet the requirements of 304(m) of the Clean Water Act. A Consent Decree was entered by the Court in January 31, 1992 (57 FR 19748); as modified in 1994, the Consent Decree requires that EPA promulgate effluent limitations guidelines and standards for the Industrial Laundries Point Source Category in 1998 (59 FR 25859). In 1997, EPA negotiated new proposal and promulgation deadlines with the NRDC; as a result, EPA must now promulgate the rule for the industrial laundries industry by June 1999 (62 FR 8726).

6.3 Industry Scope

One of the steps in developing pretreatment standards for the industrial laundries industry was determining the scope of the industry. EPA reviewed data collected from responses to the detailed questionnaires, during site and sampling visits to industrial laundries, and in previous Agency efforts to regulate this industry to define the scope and applicability of the regulation.

Initially, EPA reviewed laundry processes and associated water use and wastewater discharge practices to determine if facilities that used and/or discharged little or no water could be eliminated from the scope of the rule. Based on the data collected by EPA, 97 percent of all laundering performed by industrial laundries is water washing. As discussed in Chapters 4 and 5, industrial laundry treated by oil-only dust control mop treatment generates no wastewater. Therefore, oil-only dust control mop treatment is proposed to be excluded from regulation under the proposed rule. Industrial laundry treated by dry cleaning generates little wastewater, which typically contains very low concentrations of pollutants. Because this process generates an insignificant amount of wastewater, it is proposed to be excluded from regulation under the proposed rule. Only water-washing laundering processes are included in the scope of the rule. In addition, one facility reported dyeing of new items. EPA does not consider dyeing of new items to be a laundering process; therefore, it is also excluded from the scope of the proposed rule. Dyeing of used textile items such as shop and printer towels/rags, which is often performed as part of the washing process, is included in the scope of the rule.

EPA then looked at the types of items that were water-washed to determine if any specific items should be excluded from regulation. EPA performed a statistical comparison of raw wastewater from facilities laundering primarily linen items and raw wastewater from facilities laundering primarily industrial laundry items. EPA also performed a statistical comparison of raw wastewater from facilities laundering primarily linen items and raw wastewater from facilities performing denim prewashing. A summary of the statistical comparison is presented below and a detailed discussion is presented in the Statistical Support Document(1).

Data from EPA's sampling program and the detailed monitoring questionnaire (DMQ) were used in comparing raw linen wastewater to raw industrial laundry wastewater. EPA used data from facilities processing between 60 and 99 percent linen items to represent raw linen wastewater; EPA did not have data available for facilities processing 100 percent linen items. EPA first performed a statistical analysis of the linen wastewater data and a statistical analysis of the industrial laundry wastewater data to determine whether the data were statistically different. If data for a pollutant were determined to be significantly different among the linen wastewater data or among the industrial laundry wastewater data, that pollutant was not included in the comparison. Based on this analysis, a comparison of linen wastewater data and industrial laundry wastewater data could be performed for eight pollutants. These pollutants and the results of the comparison are shown in Table 6-1. Table 6-1 shows that industrial laundry raw wastewater concentrations are significantly different from linen raw wastewater concentrations for all eight pollutants. Also, the industrial laundry wastewater mean concentration is consistently higher than the linen wastewater mean concentration for all eight pollutants. Although the linen facilities were processing less than 100 percent linen, EPA assumes that the results of the statistical comparison would be valid if these facilities were processing 100 percent linen items.

Data from EPA's sampling program, the DMQ, and data obtained from a site visit were used in comparing raw linen wastewater to raw denim prewash wastewater. Raw denim prewash wastewater data were available for only one facility. EPA performed a statistical analysis of the linen wastewater data to determine whether the data were statistically different. Based on this analysis, a comparison of linen wastewater data and denim prewash wastewater data could be performed for seven pollutants. These pollutants and the results of the comparison are shown on Table 6-2. Table 6-2 shows that raw linen wastewater concentrations are significantly higher than raw denim prewash wastewater concentrations for cadmium, chromium, and copper, but the concentrations are similar for the other five pollutants.

Based on the results of the statistical analyses and the relatively low pollutant concentrations found in linen and denim prewash wastewater, EPA decided to exclude linen and denim prewash items from the scope of the proposed rule.

EPA is also proposing to exclude on-site laundries from the applicability of the rule. The focus of this rule is industrial laundries that function independently of other industrial activities that generate wastewater. EPA believes it is more appropriate to address on-site laundry discharges at industrial facilities as part of the effluent from the facility as a whole, for several reasons. First, many such facilities commingle laundry wastewater with wastewater from other processes. Second, EPA anticipates that contaminants removed from laundered items can best be treated with process wastewater containing similar contaminants. EPA has already established categorical effluent guidelines and standards for 51 industries, as listed in Appendix C of this document. These regulations generally apply to wastewater generated from these industries, including on-site laundering. For example, the OCPSF effluent guidelines control discharges from garment laundering at OCPSF facilities. For industries not yet covered

Table 6-1

Comparison of Linen Facility and Industrial Laundry Facility Mean Pollutant Log Concentrations

Analyte	Type of Facility	Sample Size	Mean log Concentration	Mean Concentration (mg/L)	P-value	Significant at a=0.01?
TPH (as SGT-HEM)	Industrial Laundry	30	6.05	425	0.0001	Yes
	Linen	5	2.64	14		
Oil and Grease (as HEM)	Industrial Laundry	8	7.18	1310	0.0012	Yes
	Linen	8	4.56	96		
Total Suspended Solids	Industrial Laundry	34	7.10	1206	<0.0001	Yes
	Linen	9	5.08	161		
Cadmium	Industrial Laundry	34	-2.66	.070	0.0001	Yes
	Linen	15	-4.33	.013		
Chromium	Industrial Laundry	34	-1.47	.230	<0.0001	Yes
	Linen	15	-3.19	.041		
Copper	Industrial Laundry	34	0.85	2.32	<0.0001	Yes
	Linen	15	-1.54	.21		
Iron	Industrial Laundry	34	3.23	25.2	<0.0001	Yes
	Linen	5	1.00	2.71		
Zinc	Industrial Laundry	34	1.47	4.16	<0.0001	Yes
	Linen	17	1.15	0.32		

Table 6-2

Comparison of Linen Facility and Denim Prewash Facility Mean Pollutant Log Concentrations

Analyte	Type of Facility	Sample Size	Mean log (Conc)	Mean Concentration (mg/L)	p-value	Significant at a=0.01?
Oil and Grease (as HEM)	Linen	8	4.56	95	0.018	No
	Denim Prewash	7	2.96	19		
Total Suspended Solids	Linen	9	5.08	161	0.021	No
	Denim Prewash	15	6.15	470		
Cadmium	Linen	15	-4.33	0.013	0.0001	Yes
	Denim Prewash	13	-5.68	0.003		
Chromium	Linen	15	-3.19	0.04	0.0014	Yes
	Denim Prewash	13	-4.47	0.01		
Copper	Linen	15	-1.54	0.21	0.001	Yes
	Denim Prewash	13	-2.85	0.06		
Iron	Linen	5	1.00	2.71	0.027	No
	Denim Prewash	12	-0.69	0.50		
Zinc	Linen	17	-1.15	0.32	0.114	No
	Denim Prewash	8	-2.87	0.06		

by effluent limitations guidelines and standards, it makes sense to examine these industries and the wastewater treatment processes at these industrial facilities in the context of the entire industrial facility, not just the laundering portion of the facility. Addressing on-site laundering discharges along with other industrial discharges in an industry allows EPA to examine all of the production and processing equipment used by the industry, all of the discharges in an industry, all the potential wastewater treatment applicable to the industry, and all of the economic impacts of any such national regulation for the industrial subcategory as a whole. This is consistent with EPA's efforts to make common-sense regulatory decisions.

EPA has also considered concerns expressed by industrial launderers that by excluding on-site laundering of industrial items, EPA has created an incentive for businesses to switch from using industrial launderers covered by the rule to on-site laundering. EPA does not believe this will happen because the average increased price per pound of laundering as a result of the proposed rule ($0.003 per pound) is so small that the cost of buying the equipment and operating the equipment on site would not be justified. Furthermore, an increase in pollutant loads at the facility may necessitate additional changes in the facility's NPDES permit if it is a direct discharger or its pretreatment permit issued by the local POTW if it is an indirect discharger. Section 8 of the Economic Assessment (2) supporting this proposed rule and the Analysis of Hotels, Hospitals, and Prisons (HHPs) Database memorandum (3) contain additional information on this issue.

Based on these analyses, EPA determined the facilities within the scope of the proposed rule. Industrial laundries that would be in scope include any facility that launders industrial textile items from off site as a business activity (i.e., launders industrial textile items for other business entities for a fee or through a cooperative agreement). Either the industrial laundry or the off-site customer may own the industrial laundered textile items; this includes textile rental companies that perform laundering operations. Laundering in this definition means washing with water, including water washing following dry cleaning. This rule would not apply to laundering exclusively through dry cleaning. Industrial textile items include, but are not limited to industrial: shop towels, printer towels/rags, furniture towels, rags, mops, mats, rugs, tool covers, fender covers, dust-control items, gloves, buffing pads, absorbents, uniforms, filters, and clean room items. If any of these items are used by hotels, hospitals, or restaurants, they are not industrial items. For a facility that meets this definition, wastewater from all water-washing operations would be covered by the proposed rule, including wastewater from the washing of linen items, as long as these items do not constitute 100 percent of the items washed.

The proposed rule would not apply to discharges from on-site laundering at industrial facilities, laundering of industrial textile items within the same business entity, and facilities that exclusively launder linen items, denim prewash items, new items (i.e., items directly from the textile manufacturer, not yet used for their intended purpose), any other laundering of hospital, hotel, or restaurant items or any combination of these items. This proposed rule does apply to hotel, hospital, or restaurant laundering of industrial textile items. In addition, this proposed rule would not apply to the discharges from oil-only treatment of mops. Linen items are sheets, pillow cases, blankets, bath towels and washcloths, hospital gowns and robes, tablecloths, napkins, tableskirts, kitchen textile items, continuous roll towels, laboratory coats, household laundry (such as clothes, but not industrial uniforms), executive wear, mattress pads, incontinence pads, and diapers. EPA intends this to be an all-inclusive list.

6.4 Subcategorization Analysis

EPA assessed several factors to determine whether segmenting or subcategorizing the Industrial Laundries Point Source Category is appropriate. These factors are listed below:

- Disproportionate economic impacts;
- Laundry processes and water use practices;
- Plant age;
- Plant location;
- Plant size;
- Raw materials;
- Non-water quality environmental impacts (energy usage, air emissions, and solid waste generation); and
- Type of item laundered and wastewater characteristics.

Based on the results of this examination, EPA has determined that the Industrial Laundries Point Source Category warrants no subcategorization. However, the proposed PSES contain an exclusion for small facilities due to disproportionate economic impacts. The remainder of this section discusses EPA's analysis of each of these factors.

6.4.1 Disproportionate Economic Impacts

EPA looked at production as a means of defining applicability of the rule, since EPA commonly uses production as a good indicator of size because it is easily measured and closely tracked by the industry. In examining production levels, EPA determined that larger industrial laundries have an advantage over small facilities: they enjoy economy of scale in treating their wastewater and generally have more economic resources than small facilities. Because of these differences in economy of scale and economic resources, a disproportionate amount of negative economic impacts would occur at small facilities following implementation of this rule. EPA did a breakpoint analysis and determined that disproportionate impacts occur at facilities with production of less than one million pounds per year and less than 255,000 pounds per year of shop and printer towels/rags. Appendix E of the Economic Assessment presents EPA's rationale for this exclusion.

Under Pretreatment Standards for Existing Sources (PSES), EPA is proposing to exclude existing facilities processing less than one million pounds of incoming laundry per calendar year and less than 255,000 pounds of shop towels and/or printer towels/rags per calendar year. EPA proposes this exclusion to eliminate the unacceptable economic impacts on these smaller facilities that would occur without the exclusion. Appendix E of the Economic Assessment contains a more detailed discussion of this exclusion. As a result of this exclusion, there would be a decrease of less than three percent in the pollutant removals achieved under the proposed rule.

Under Pretreatment Standards for New Sources (PSNS), EPA is proposing no exclusions since the economic projections indicate that there would be no barrier to entry as a result of the proposed new source standards.

6.4.2 Laundry Processes and Water Use Practices

EPA looked at laundering processes and water use practices in terms of a possible basis for subcategorization. As discussed in Section 6.3, EPA examined laundry operations and wastewater characteristics in defining the scope of the industry. EPA examined operations that generate wastewater and those that do not, and excluded those operations that do not generate wastewater. EPA then evaluated the wastewater characteristics for all water-washing operations, which includes dry cleaning followed by water washing. Based on the evaluation, EPA determined that wastewater characteristics are similar for all laundry water-washing operations, and therefore do not provide an adequate basis for subcategorization. Wastewater characteristics are primarily a function of the types of items laundered, and not the facility's laundering processes.

6.4.3 Plant Age

The age of an industrial laundry is an indefinite parameter primarily because of the upgrading and modernization that most facilities do to remain competitive, as discussed in Chapter 4. EPA is therefore not considering plant age as a basis for subcategorization.

6.4.4 Plant Location

Industrial laundries are located throughout the United States and are not generally limited to any one geographical location, as discussed in Chapter 4. EPA did not subcategorize based on geographical location because location does not affect the ability of industrial laundries to comply with the proposed rulemaking.

6.4.5 Plant Size

In analyzing plant size as a basis for subcategorization and also as part of the analysis to minimize any disproportionate economic impacts, EPA examined the following factors to determine if any of them would be appropriate as a basis of subcategorization: number of employees, wastewater discharge flow rate, and production. The analysis of each of these factors is discussed below.

Number of Employees.

Raw materials, laundering processes, and wastewater characteristics are independent of the number of employees at a facility. It is difficult to correlate the number of employees to wastewater generation due to variations in laundry staffing. Fluctuations can occur for many reasons, including shift differences, clerical and administrative support staff, maintenance workers, efficiency of site operations, and market fluctuations. For these reasons, EPA did not subcategorize by number of employees.

Wastewater Discharge Flow Rate.

EPA did not subcategorize by wastewater discharge flow rate because the wastewater characteristics for a facility are independent of the overall wastewater discharge flow rate from a facility. Wastewater characteristics are primarily a function of the types of items laundered at a facility, and not the facility's overall wastewater discharge flow rate. For example, a facility laundering 100 pounds of laundry and discharging 300 gallons per year of wastewater would have wastewater characteristics similar to a facility processing 100,000 pounds of laundry and discharging 300,000 gallons of wastewater per year, provided the facilities are laundering similar items.

Production.

As with wastewater discharge flow rate, wastewater characteristics for a facility are independent of the overall production volume at a facility. Wastewater characteristics are primarily a function of the types of items laundered at a facility, and not the facility's overall production, as shown in the example discussed in the previous paragraph of this section.

In addition, as discussed in Section 6.4.1, EPA looked at production in determining the applicability of the proposed rule to the industry. As a result, EPA is proposing to exclude from regulation existing facilities that process less than one million pounds of incoming laundry per calendar year and less than 255,000 pounds of shop towels/rags.

6.4.6 Raw Materials

The raw materials used in the industrial laundries industry primarily consist of chemicals used in the laundering process. Chemicals that are frequently used in the industry include alkaline solutions, detergent, bleach, antichlor, sour, softener, and starch; other chemicals used include enzymes, builders, oil treatment chemicals, water conditioners, dyes, stain treatment chemicals, and bactericides. The chemicals most commonly used across the industry and on a variety of laundry items are detergent, bleach, and sour. Chemical usage varies from wash cycle to wash cycle depending on product mix and equipment laundering. Waste load and wastewater treatability are not directly correlated to chemicals used in laundering. Because of the wide variety of chemicals and wash formulas used in the industry and the complexities involved in laundering chemistry, EPA determined it was not appropriate to subcategorize based on chemicals used in the laundering process.

6.4.7 Non-water Quality Environmental Impacts

Non-water quality environmental impacts for the industrial laundries industry include wastewater treatment residual and sludge disposal, air emissions, and energy requirements. As discussed in Chapter 14, EPA estimates that minimal non-water quality impacts would result from implementation of this proposed regulation. Therefore, EPA determined that these non-water quality environmental impacts are not an adequate basis for subcategorizing the industrial laundries industry.

6.4.8 Type of Item Laundered and Wastewater Characteristics

As discussed in Section 6.3 of this document, the types of items laundered by facilities covered under the scope of this rulemaking include, but are not limited to, the following industrial textile items: shop towels, printer towels/rags, furniture towels, rags, mops, mats, rugs, tool covers, fender covers, dust-control items, gloves, buffing pads, absorbents, uniforms, and clean room garments. Laundering of linen items is also covered when industrial items are laundered at the same facility.

EPA examined type of item laundered as a possible basis of subcategorization, as different items cleaned usually generate different wastewater characteristics. As presented in Chapter 5, printer towels/rags, shop towels, and mops generally have concentrations of pollutants that are greater than the concentrations for floor mats and industrial garments. Laundering of printer towels/rags and shop towels generates 67 percent of the toxic-weighted wastewater pollutant load from the industry, although these items represent only 5 percent of the total industry production and 10 percent of the total industrial laundry production.

EPA considered requiring different wastewater limitations for wastewater generated from laundering printer towels/rags, shop towels, and mops than for wastewater generated from laundering other items. However, laundries typically clean a variety of items and typically combine wastewater from all items laundered. Thus, subcategorizing the industry by type of item laundered with different limitations for different types of items would require segregation and separate treatment of wastestreams. To be effective, separate limitations for wastewater for specific laundry items would require the use of in-plant limitations. Requiring industrial laundries to segregate wastewater and treat the segregated streams separately adds complexity to the regulation that is unnecessary. In addition, most facilities that reported having treatment in the detailed questionnaire treat all of their wastewater from laundering of all items. Also, most industrial laundries currently sample only their total facility effluent at the point of discharge to the POTW. Implementation of in-plant limits would place an additional recordkeeping burden on both the industry and permit writers and would increase the costs for the industry to comply with the proposed rule.

6.5 References

1. U.S. Environmental Protection Agency. Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA-821-R-97-006, Washington, DC, November 1997.

2. U.S. Environmental Protection Agency. Economic Assessment for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA-821-R-97-008, Washington, DC, November 1997.

3. Memorandum: Analysis of Hotels, Hospitals, and Prisons (HHPs) Database, February 21, 1997.

CHAPTER 7

POLLUTANTS SELECTED FOR REGULATION

7.1 Introduction

EPA collected data to determine the conventional, priority, and nonconventional pollutants to be regulated for the industrial laundries proposed rule. Conventional pollutant parameters are defined in section 304(a)(4) of the Clean Water Act (CWA) and in 40 CFR Part 401.16 and include biochemical oxygen demand (BOD_5), total suspended solids (TSS), total recoverable oil and grease, pH, and fecal coliform. These pollutants are subject to regulation as specified in sections 301(b)(2)(E) and 304(b)(4)(B) of the CWA. Toxic or priority pollutants are defined in section 307(a)(1) of the CWA. The list of priority pollutants, presented in Table D-1 in Appendix D of this document, consists of 126 specific pollutants listed in 40 CFR Part 423, Appendix A. Sections 301(b)(2)(C) and 304(b)(2)(B) of the CWA authorize EPA to regulate priority pollutants. Nonconventional pollutants are those that are neither priority pollutants or conventional pollutants. Sections 301(b)(2)(F), 301(g), and 304(b)(2)(B) of the CWA give EPA the authority to regulate nonconventional pollutants.

This chapter presents the methodology used to select pollutants for regulation under the proposed industrial laundries rule. Section 7.2 discusses the pollutants considered for regulation. Section 7.3 discusses the criteria used to identify pollutants of concern from the list of pollutants considered for regulation. Section 7.4 discusses the criteria used to select pollutants for regulation, including the pass-through analysis, from the pollutants of concern list, and Section 7.5 presents the references used.

7.2 Pollutants Considered for Regulation

EPA considered four conventional, 98 priority, and 213 nonconventional organic, metal, and elemental pollutant parameters for potential regulation for the industrial laundries industry. Three hundred and twelve (312) of these pollutants are listed in The Industrial Technology Division List of Analytes, which was derived from the List of Lists (1). Three pollutants not on this list were also considered for regulation. EPA analyzed industrial laundry wastewater for these 315 pollutants during the 1993-1996 industrial laundries sampling program, which is discussed in Chapter 3. Table D-2 in Appendix D lists the 315 pollutants analyzed by EPA in industrial laundry wastewater during this sampling program. EPA used data collected from seven industrial laundries for selecting pollutants of concern and regulated pollutants.

For the industrial laundries industry, EPA used the newly proposed EPA Method 1664 to analyze for oil and grease and total petroleum hydrocarbons (TPH) because the currently approved method for analyzing these parameters uses freon, which is being phased out of use. Method 1664 has been proposed to measure oil and grease as hexane extractable material (HEM) and to measure TPH as silica gel treated-hexane extractable material (SGT-HEM).

Several conventional and priority pollutants were not considered for regulation for the industrial laundries industry based on the following: information collected during the 1985-1987 industrial laundries sampling program, described in Chapter 3; information collected from the Detailed Monitoring Questionnaire (DMQ), described in Chapter 3; and EPA's knowledge of industrial laundry wastewater. The DMQ was sent to 37 facilities selected from respondents to the 1994 Industrial Laundries Industry Detailed Questionnaire. The recipients submitted monitoring data collected at their facility during 1993.

EPA did not consider the following conventional and priority pollutants for regulation for the industrial laundries industry:

- Fecal coliform;
- Asbestos;
- 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD);
- Twenty-five (25) pesticides and PCBs (pollutants 89 through 113 on Table D-1 in Appendix D); and
- Cyanide.

EPA does not expect fecal coliform bacteria to be present in industrial laundry wastewaters because the laundering chemicals added to laundry process water and the temperature of the water will likely destroy fecal coliform that may have been present on laundered items.

EPA does not expect asbestos to be present in industrial laundry wastewaters because it is not expected to be present on items laundered by industrial laundries or generated during the washing process.

EPA does not expect dioxins and furans, including 2,3,7,8-TCDD, to be present on industrial laundry items and EPA does not expect dioxins and furans to be formed during industrial laundry processes. Dioxins and furans were not detected in available industrial laundry wastewater samples collected during three sampling episodes during the 1985-1987 sampling program (dioxins and furans were not analyzed for during the other two episodes). One facility responding to the DMQ questionnaire submitted data for 2,3,7,8-TCDD; this compound was not detected at the facility. A review of POTW permits for 92 industrial laundries indicated that none of the facilities have limits for dioxins and furans.

EPA did not consider PCBs for regulation because PCBs were not detected in available industrial laundry wastewater samples from four sampling episodes during the 1985-1987 sampling program (PCBs were not analyzed for during one other episode). Four facilities responding to the DMQ submitted data for up to seven PCBs; PCBs were not detected at any of the four facilities. A review of publicly owned treatment works (POTW) permits for 92 industrial laundries indicated that only one of the facilities has limits for PCBs.

EPA did not consider pesticides for regulation because most priority pesticides were detected in less than 10 percent of available industrial laundry wastewater samples and the presence of pesticides in industrial laundry wastewater is a site-specific issue related to a particular customer base. Pesticides are best addressed through case-by-case review of specific circumstances rather than a national regulation. Pesticides were analyzed for at four facilities during the 1985-1987 sampling program, and ten DMQ facilities submitted pesticide data. Of the 18 priority pollutant pesticides, the following three pesticides were detected in 10 percent or greater of industrial laundry wastewater samples:

- Heptachlor (10 percent);
- delta-BHC (14 percent); and
- Endosulfan sulfate (14 percent).

Heptachlor was detected at 2 facilities (sampled at 14 facilities), delta-BHC was detected at 2 facilities (sampled at 11 facilities), and endosulfan sulfate was detected at 4 facilities (sampled at 11 facilities). Endosulfan sulfate and dieldrin were the only priority pollutant pesticides detected at concentrations greater than 0.1 mg/L, and detections at these concentrations occurred at only one facility of 11 facilities sampled for each pesticide. Also, review of POTW permits for 92 industrial laundries indicated that only one of the facilities has limits for pesticides.

EPA did not consider cyanide for regulation because cyanide was detected at most facilities at insignificant concentrations. Cyanide was analyzed at five facilities during the 1985-1987 sampling program, and 16 DMQ facilities submitted cyanide data. Only two of these facilities reported detected concentrations of cyanide greater than 1 mg/L and only one of these facilities had an average detected concentration greater than 1 mg/L. Cyanide was not detected at five facilities, and cyanide was detected at average concentrations of less than 0.1 mg/L at eight facilities.

The maximum contaminant level for cyanide, as established in the National Primary Drinking Water Regulations (40 CFR Part 141), is 0.2 mg/L, as free cyanide. Only one DMQ facility reported an average cyanide concentration greater than 0.2 mg/L. This facility did not report the analytical method used. Two facilities from the 1985-1987 sampling program had average cyanide concentrations greater than 0.2 mg/L, but these concentrations were measured as total cyanide.

7.3 Identification of Pollutants of Concern

In assessing the 315 pollutant parameters analyzed during the 1993-1996 industrial laundries sampling program, EPA used the following criteria to identify pollutant parameters of concern. EPA reduced the list of 315 pollutants to 72 pollutants for further consideration using the following criteria:

- Pollutants never detected in any samples collected during seven sampling episodes during the 1993-1996 industrial laundries sampling program. Table 7-1 lists the 175 pollutants meeting this criterion.

- Pollutants detected in less than 10 percent of samples collected during seven sampling episodes during the 1993-1996 industrial laundries sampling program. Table 7-2 lists the 50 pollutants meeting this criterion.

- Pollutants identified during screening, but not quantified due to a lack of an acceptable analytical method. Eight metal and elemental pollutants that were detected in industrial laundry samples greater than 10 percent of the time were not analyzed in a quantitative manner. Analyses for these pollutants were not subject to the quality assurance/quality control (QA/QC) procedures required by analytical Method 1620. These metals were used for screening purposes only and were excluded from the pollutants of concern because they are not quantified. Table 7-3 lists these metal pollutants.

- Pollutants detected in source water at comparable concentrations to industrial laundry raw wastewater. Three nonconventional metal pollutants (calcium, magnesium, and sodium) were excluded because EPA believes that these pollutants are present in source water at concentrations similar to quantities present on industrial laundry items and generated from industrial laundry processes, based on comparing the concentrations of these pollutants in source water from seven sampling episodes to the concentrations in industrial laundry wastewater.

- Pollutants likely to be regulated on a case-by-case basis by POTWs. The following six pollutants were eliminated from the pollutant-of-concern list:

  — pH: this pollutant is typically regulated as necessary by POTWs. pH is not considered for national regulation for the industrial laundries industry.

Table 7-1

Pollutants Not Detected in Any Samples Analyzed during the 1993-1996 Industrial Laundries Sampling Program

Pollutant	Class Code	Pollutant	Class Code
Acenaphthene	TXO	Vinyl Chloride	TXO
Acenaphthylene	TXO	1,1,2-Trichloroethane	TXO
Anthracene	TXO	1,2-Dichlorobenzene	TXO
Benzidine	TXO	1,2-Dichloropropane	TXO
Benzo(a)anthracene	TXO	1,2,4-Trichlorobenzene	TXO
Benzo(a)pyrene	TXO	1,3-Dichlorobenzene	TXO
Benzo(b)fluoranthene	TXO	1,4-Dichlorobenzene	TXO
Benzo(ghi)perylene	TXO	2-Chloronaphthalene	TXO
Benzo(k)fluoranthene	TXO	2,4-Dinitrotoluene	TXO
Bis(2-chloroisopropyl)ether	TXO	3,3'-Dichlorobenzidine	TXO
Bromomethane	TXO	4-Bromophenyl Phenyl Ether	TXO
Chloroethane	TXO	4-Chlorophenylphenyl Ether	TXO
Chloromethane	TXO	Aniline, 2,4,5-Trimethyl	NCO
Chrysene	TXO	Aramite	NCO
Di-n-propylnitrosamine	TXO	Benzanthrone	NCO
Dibenzo(a,h)anthracene	TXO	Benzenethiol	NCO
Fluoranthene	TXO	Benzonitrile, 3,5-dibromo-4-hydroxy-	NCO
Fluorene	TXO	Beta-Naphthylamine	NCO
Hexachlorobenzene	TXO	Biphenyl, 4-Nitro	NCO
Hexachlorobutadiene	TXO	Carbazole	NCO
Hexachlorocyclopentadiene	TXO	Carbon Disulfide	NCO
Hexachloroethane	TXO	Chloroacetonitrile	NCO
Indeno(1,2,3-cd)pyrene	TXO	cis-1,3-Dichloropropene	NCO
N-Nitrosodimethylamine	TXO	Crotonaldehyde	NCO
Nitrobenzene	TXO	Crotoxyphos	NCO
Pyrene	TXO	Dibenzothiophene	NCO
Tribromomethane	TXO	Dibromomethane	NCO
Diethyl Ether	NCO	Phenacetin	NCO
Diphenyldisulfide	NCO	Phenothiazine	NCO

Table 7-1 (Continued)

Pollutant	Class Code	Pollutant	Class Code
Ethane, Pentachloro-	NCO	Pronamide	NCO
Ethyl Cyanide	NCO	Pyridine	NCO
Ethyl Methacrylate	NCO	Resorcinol	NCO
Ethyl Methanesulfonate	NCO	Squalene	NCO
Ethylenethiourea	NCO	Thianaphthene	NCO
Hexachloropropene	NCO	Thioacetamide	NCO
Iodomethane	NCO	Thioxanthe-9-one	NCO
Isosafrole	NCO	Toluene, 2,4-diamino	NCO
Longifolene	NCO	Trans-1,4-dichloro-2-butene	NCO
Malachite Green	NCO	Triphenylene	NCO
Mestranol	NCO	Vinyl Acetate	NCO
Methapyrilene	NCO	1-Bromo-2-chlorobenzene	NCO
Methyl Methanesulfonate	NCO	1-Bromo-3-chlorobenzene	NCO
N-Nitrosodi-N-butylamine	NCO	1-Chloro-3-nitrobenzene	NCO
N-Nitrosodiethylamine	NCO	1-Naphthylamine	NCO
N-Nitrosomethylethylamine	NCO	1-Phenylnaphthalene	NCO
N-Nitrosomethylphenylamine	NCO	1,1,1,2-Tetrachloroethane	NCO
N-Nitrosopiperidine	NCO	1,2-Dibromo-3-chloropropane	NCO
N,N-Dimethylformamide	NCO	1,2-Dibromoethane	NCO
o-Anisidine	NCO	1,2,3-Trichlorobenzene	NCO
o-Toluidine	NCO	1,2,3-Trichloropropane	NCO
o-Toluidine, 5-Chloro-	NCO	1,2,3-Trimethoxybenzene	NCO
p-Chloroaniline	NCO	1,2,4,5-Tetrachlorobenzene	NCO
p-Dimethylaminoazobenzene	NCO	1,2,3,4-Diepoxybutane	NCO
p-Nitroaniline	NCO	1,3-Butadiene, 2-Chloro	NCO
Pentachlorobenzene	NCO	1,3-Dichloro-2-propanol	NCO
Perylene	NCO	1,3-Dichloropropane	NCO
1,3,5-Trithiane	NCO	Bismuth	NCM
1,4-Dinitrobenzene	NCO	Cerium	NCM
1,4-Naphthoquinone	NCO	Dysprosium	NCM
1,5-Naphthalenediamine	NCO	Erbium	NCM
2-(Methylthio)benzothiazole	NCO	Europium	NCM

Table 7-1 (Continued)

Pollutant	Class Code	Pollutant	Class Code
2-Isopropylnaphthalene	NCO	Gadolinium	NCM
2-Methylbenzothioazole	NCO	Gallium	NCM
2-Nitroaniline	NCO	Germanium	NCM
2-Phenylnaphthalene	NCO	Gold	NCM
2-Picoline	NCO	Hafnium	NCM
2-Propen-1-ol	NCO	Holmium	NCM
2-Propenenitrile, 2-Methyl-	NCO	Indium	NCM
2,3-Benzofluorene	NCO	Lanthanum	NCM
2,3-Dichloronitrobenzene	NCO	Lutetium	NCM
2,3,4,6-Tetrachlorophenol	NCO	Neodymium	NCM
2,6-Di-tert-butyl-p-benzoquinone	NCO	Niobium	NCM
2,6-Dichloro-4-nitroaniline	NCO	Osmium	NCM
2,6-Dichlorophenol	NCO	Palladium	NCM
3-Chloropropene	NCO	Platinum	NCM
3-Methylcholanthrene	NCO	Praseodymium	NCM
3-Nitroaniline	NCO	Rhenium	NCM
3,3'-Dimethoxybenzidine	NCO	Rhodium	NCM
3,6-Dimethylphenanthrene	NCO	Ruthenium	NCM
4-Aminobiphenyl	NCO	Samarium	NCM
4-Chloro-2-nitroaniline	NCO	Scandium	NCM
4,4'-Methylenebis(2-chloroaniline)	NCO	Tantalum	NCM
4,5-Methylene Phenanthrene	NCO	Tellurium	NCM
5-Nitro-o-toluidine	NCO	Terbium	NCM
7,12-Dimethylbenz(a)anthracene	NCO	Thorium	NCM
Thulium	NCM	Ytterbium	NCM
Tungsten	NCM	Zirconium	NCM
Uranium	NCM		

NCM - Nonconventional metal or element.
NCO - Nonconventional organic.
TXO - Toxic organic.

Table 7-2

Pollutants Detected in Less Than 10 Percent of Samples Analyzed During the 1993-1996 Industrial Laundries Sampling Program

Priority Organics	Nonconventional Organics
Acrylonitrile	Acetophenone
Benzene	Aniline
Bis(2-chloroethoxy)methane	Biphenyl
Bis (2-chloroethyl)ether	Dibenzofuran
Bromodichloromethane	2,3-Dichloroaniline
2-Chloroethylvinyl ether	Dimethyl sulfone
2-Chlorophenol	1,4-Dioxane
Dibromochloromethane	Diphenylamine
1.1-Dichloroethane	Diphenyl ether
1,2-Dichloroethane	2-Hexanone
1,1-Dichloroethene	Isobutyl alcohol
2,4-Dichlorophenol	1-Methylfluorene
Diethyl phthalate	1-Methylphenanthrene
2,4-Dimethylphenol	Methyl methacrylate
Dimethyl phthalate	N-Nitrosomorpholine
2,4-Dinitrophenol	o-Cresol
2,6-Dinitrotoluene	Safrole
2-Nitrophenol	Styrene
4-Nitrophenol	Trichlorofluoromethane
N-Nitrosodiphenylamine	2,3,6-Trichlorophenol
Pentachlorophenol	2,4,5-Trichlorophenol
Phenanthrene	Tripropyleneglycol methyl ether
Phenol,2-Methyl-4,6-Dinitro-	
2-Propenal	
1,1,2,2-Tetrachloroethane	
Tetrachloromethane	
Trans-1,3-Dichloropropene	
2,4,6-Trichlorophenol	

Table 7-3

Semiquantitative Metal and Elemental Pollutants Excluded from the Pollutants of Concern for the Industrial Laundries Industry

Nonconventional Metals and Elements
Iodine
Iridium
Lithium
Phosphorus
Potassium
Silicon
Strontium
Sulfur

— Total orthophosphate, total phosphorous, and total hydrolyzable phosphate: Table 7-4 presents the average influent, concentrations, effluent concentrations, and percent removals for these pollutants by both the dissolved air flotation and chemical precipitation treatment technologies. These pollutants are typically regulated by water quality standards on a case-by-case basis. These pollutants are not considered for national regulation for the industrial laundries industry.

— Surfactants (nonionic (CTAS) and anionic (MBAS)): Table 7-4 presents the average influent concentrations, effluent concentrations, and percent removals for these pollutants by both the dissolved air flotation and chemical precipitation treatment technologies. These pollutants were analyzed to evaluate the effect of emulsions on treatment technologies for the industrial laundries industry. Surfactants are not considered for national regulation for the industrial laundries industry.

In addition to the pollutants above, EPA eliminated total solids from further consideration. Total solids is a measure of total dissolved solids and total suspended solids. Total suspended solids and total solids were both detected in industrial laundry wastewater. Because the measurement of total solids includes total suspended solids and because the treatment technologies under consideration as the bases of the regulation are designed to remove the suspended solids portion, not the dissolved solids portion, EPA eliminated total solids from further consideration.

Of the 315 pollutants considered for regulation, 72 were identified as pollutant parameters of concern, including 31 priority pollutants (18 organic pollutants and 13 metal and elemental pollutants), three conventional pollutants, and 38 nonconventional pollutants (24 organic pollutants, 11 metal and elemental pollutants, and three other nonconventional pollutants). Table 7-5 presents these 72 pollutants, along with the number of times each pollutant was analyzed and detected in untreated industrial laundry wastewater, and the corresponding mean, minimum, and maximum concentrations.

7.4 Pollutants Selected for Regulation

This section presents the pollutant parameters selected for regulation for the proposed rule for the Industrial Laundries Point Source Category. These parameters were chosen from the list of 72 pollutant parameters of concern discussed above. Although all 72 pollutant parameters of concern were used to estimate compliance costs, pollutant loadings, and pollutant reductions, only certain parameters were selected for regulation. Because the list of pollutants of concern is rather large, EPA has chosen to propose a subset of these pollutants for regulation

Table 7-4

Average Influent Concentrations, Effluent Concentrations, and Removals for Phosphorous and Surfactants

Pollutant	Average Influent (mg/L)	Average Effluent (mgL)	Average Percent Removal
Chemical Precipitation			
Total Hydrolyzable Phosphorous	67.6	0.363	>99
Total Orthophosphate	No Data	No Data	No Data
Total Phosphorous	42.0	0.992	98
Surfactants (anionic)	12.0	6.23	48
Surfactants (nonionic)	109	43.4	60
Dissolved Air Flotation			
Total Hydrolyzable Phosphorous	10.8	5.15	52
Total Orthophosphate	6.88	2.95	57
Total Phosphorous	21.4	8.94	58
Surfactants (anionic)	7.64	0.818	89
Surfactants (nonionic)	446	202	55

Table 7-5

Pollutants of Concern for the Industrial Laundries Industry

Pollutant	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	46	46	100.00	218.00	9810.00	2343.50
Oil and Grease (measured as HEM)	48	48	100.00	71.50	11790.00	1943.92
Total Suspended Solids (TSS)	46	45	97.83	4.00	7000.00	1773.93
Priority Organics						
1,1,1-Trichloroethane	48	22	45.83	0.01	156.64	4.01
1,2-Diphenylhydrazine	47	5	10.64	0.02	41.32	1.14
4-Chloro-3-methylphenol	47	8	17.02	0.01	2.06	0.14
Bis(2-ethylhexyl) Phthalate	47	43	91.49	0.04	42.01	6.80
Butyl Benzyl Phthalate	47	20	42.55	0.01	74.42	2.69
Chlorobenzene	48	8	16.67	0.01	1.41	0.08
Chloroform	48	25	52.08	0.01	1.19	0.07
Di-*n*-butyl Phthalate	47	20	42.55	0.01	9.98	0.73
Di-*n*-octyl Phthalate	47	25	53.19	0.01	2.61	0.30
Ethylbenzene	48	38	79.17	0.01	18.74	1.24
Isophorone	47	5	10.64	0.01	1.00	0.12
Methylene Chloride	48	25	52.08	0.01	16.26	0.63
Naphthalene	47	42	89.36	0.01	18.75	2.59
Phenol	47	23	48.94	0.01	0.96	0.15
Tetrachloroethene	48	35	72.92	0.01	46.22	1.97
Toluene	48	44	91.67	0.01	90.97	6.72

Table 7-5 (Continued)

Pollutant	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Priority Organics (Continued)						
trans-1,2-Dichloroethene	48	1	2.08	0.01	0.10	0.03
Trichloroethene	48	7	14.58	0.01	20.00	0.48
Nonconventional Organics						
2-Butanone	48	32	66.67	0.05	272.29	9.07
2-Methylnaphthalene	47	32	68.09	0.01	2.24	0.41
2-Propanone	48	46	95.83	0.05	603.15	20.95
4-Methyl-2-pentanone	48	26	54.17	0.05	65.27	2.65
∝-Terpineol	47	17	36.17	0.01	5.20	0.33
Benzoic Acid	47	34	72.34	0.05	12.23	1.77
Benzyl Alcohol	47	21	44.68	0.01	12.52	0.81
Hexanoic Acid	47	14	29.79	0.01	1.81	0.12
m-Xylene	48	40	83.33	0.01	25.29	2.29
n-Decane	47	41	87.23	0.01	712.40	51.60
n-Docosane	47	31	65.96	0.01	3.04	0.35
n-Dodecane	47	40	85.11	0.01	105.57	14.37
n-Eicosane	47	43	91.49	0.01	84.57	4.06
n-Hexacosane	47	27	57.45	0.01	3.73	0.36
n-Hexadecane	47	43	91.49	0.01	91.57	6.70
n-Octacosane	47	21	44.68	0.01	1.44	0.19
n-Octadecane	47	42	89.36	0.01	19.36	1.92
n-Tetracosane	47	25	53.19	0.01	8.34	0.46

Table 7-5 (Continued)

Pollutant	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Nonconventional Organics (Cont.)						
n-Tetradecane	47	37	78.72	0.01	41.58	4.39
n-Triacontane	47	29	61.70	0.01	1.00	0.19
o-&*p*-Xylene	48	40	83.33	0.01	17.80	1.59
p-Cresol	47	1	2.13	0.01	0.20	0.06
p-Cymene	47	16	34.04	0.01	19.81	1.43
Pentamethylbenzene	47	11	23.40	0.01	2.33	0.22
Priority Metals and Elements						
Antimony	47	34	72.34	0.01	8.24	0.26
Arsenic	47	15	31.91	0.010	0.18	0.02
Beryllium	47	18	38.30	0.010	0.02	0.003
Cadmium	47	44	93.62	0.010	0.70	0.10
Chromium	47	45	95.74	0.010	7.31	0.46
Copper	47	47	100.00	0.04	14.90	3.17
Lead	47	45	95.74	0.03	23.80	1.71
Mercury	47	28	59.57	0.010	0.01	0.001
Nickel	47	45	95.74	0.01	2.87	0.27
Selenium	47	12	25.53	0.010	0.26	0.03
Silver	47	24	51.06	0.010	0.17	0.02
Thallium	47	6	12.77	0.010	0.13	0.01
Zinc	47	46	97.87	0.010	29.40	5.02

Table 7-5 (Continued)

Pollutant	Number of Times Analyzed	Number of Times Detected	Percent Detected (%)	Concentration in Untreated Wastewater (mg/L)		
				Minimum	Maximum	Mean
Nonconventional Metals and Elements						
Aluminum	47	47	100.00	0.03	20.99	7.96
Barium	47	47	100.00	0.03	6.26	1.51
Boron	47	36	76.60	0.03	37.20	2.31
Cobalt	47	37	78.72	0.000	3.10	0.24
Iron	47	47	100.00	0.06	96.60	27.70
Manganese	47	47	100.00	0.02	1.77	0.56
Molybdenum	47	43	91.49	0.010	5.17	0.53
Tin	47	32	68.09	0.02	0.58	0.11
Titanium	47	45	95.74	0.01	1.32	0.23
Vanadium	47	31	65.96	0.010	0.19	0.04
Yttrium	47	15	31.91	0.010	0.04	0.01
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	47	47	100.00	80.00	212000.00	12730.57
Total Organic Carbon (TOC)	47	47	100.00	106.00	37800.00	2208.32
Total Petroleum Hydrocarbon (measured as SGT-HEM)	43	43	100.00	7.00	4543.00	880.86

to streamline the control and compliance process. Moreover, monitoring for all 72 pollutants of concern is not necessary to ensure that industrial laundry wastewater pollutants are adequately controlled, since many of the pollutants originate from similar sources and have similar properties. EPA selected the pollutants for regulation to represent the entire population of the pollutants of concern; they include metals, volatile organics, and semivolatile organics. Table 7-6 presents the pollutants selected for proposed regulation. The rationale for selecting these pollutants is discussed below.

7.4.1 Elimination of Parameters that Comprise TPH

EPA is not specifically controlling the following eleven straight chain alkane (*n*-alkanes) pollutants in the proposed rule because EPA believes these pollutants comprise a portion of TPH, measured as SGT-HEM, and thus would be controlled by EPA's regulation of TPH:

- *n*-Decane;
- *n*-Docosane;
- *n*-Dodecane;
- *n*-Eicosane;
- *n*-Hexacosane;
- *n*-Hexadecane;
- *n*-Octacosane;
- *n*-Octadecane;
- *n*-Tetracosane;
- *n*-Tetradecane; and
- *n*-Triacontane.

7.4.2 Elimination of Treatment Chemicals

EPA eliminated aluminum and iron from the proposed regulation because aluminum and iron are commonly added to wastewater as treatment chemicals in the industrial laundries industry. Regulation of aluminum and iron could interfere with their beneficial use as wastewater treatment additives.

7.4.3 Elimination of Pollutants Not Treated or Below Treatable Concentrations

EPA eliminated pollutants from the proposed regulation when the pollutants were not removed by the treatment technologies under consideration as the bases for the regulation. EPA also eliminated pollutants when the pollutants were present below treatable concentrations in wastewater influent to the treatment systems sampled, and therefore would not be substantially removed by the treatment technologies under consideration. For the purposes of this proposed rule, EPA only used data greater than 10 times the method detection level for each pollutant to reliably evaluate treatment effectiveness within the consistent operating range of the main treatment technologies considered.

Table 7-6

Pollutants Selected for Proposed Regulation in the Industrial Laundries Industry

Pollutant
Priority Organics
Bis(2-ethylhexyl) Phthalate
Ethylbenzene
Naphthalene
Tetrachloroethene
Toluene
Nonconventional Organics
m-Xylene[1]
o-&*p*-Xylene[1]
Priority Metals
Copper
Lead
Zinc
Bulk Nonconventionals
Total Petroleum Hydrocarbon (measured as SGT-HEM)[2]

[1]EPA is proposing the use of EPA Methods 1624 and 624 for the analysis of xylenes, even though xylenes are not specifically listed as an analyte in either of these methods (promulgated at 40 CFR Part 136). EPA used data obtained from the analysis of xylenes by these two methods in the development of the proposed industrial laundry standards.
[2]Total Petroleum Hydrocarbons (measured as SGT-HEM) is total petroleum hydrocarbons measured by the silica gel treated-hexane extractable material (SGT-HEM) analytical method proposed January 23, 1996 (Method 1664).

EPA considered two main technologies as the bases for the regulatory options (see Chapter 10 for a description of the regulatory options). The two technologies arechemical precipitation and dissolved air flotation (DAF). For each of these technologies, EPA eliminated a different set of pollutants from further consideration for regulation based on treatability. For chemical precipitation, EPA eliminated 31 pollutants from further consideration for regulation. Table 7-7 lists these pollutants and the reasons the pollutants were eliminated. For DAF, EPA eliminated 19 pollutants from further consideration for regulation; Table 7-8 lists these pollutants and the reasons the pollutants were eliminated.

7.4.4 Elimination of Pollutants that Do Not Pass Through or Otherwise Interfere with POTWs

Section 307(b) of the Clean Water Act requires EPA to promulgate pretreatment standards for indirect dischargers to ensure removal of pollutants which pass through, interfere with, or are incompatible with the operation of POTWs. Pollutants shown to pass through a POTW may be regulated by pretreatment standards. This section presents a brief background of EPA's guidance and methods used for evaluating pass through, and the results of the pass-through evaluation.

7.4.4.1 Background

Before proposing pretreatment standards, EPA examines whether the pollutants discharged by the industry pass through a POTW to waters of the U.S. or interfere with the POTW operation or sludge disposal practices. Generally, in determining whether pollutants pass through a POTW, EPA compares the percentage of the pollutant removed by well-operated POTWs achieving secondary treatment with the percentage of the pollutant removed by facilities meeting BAT effluent limitations. For the industrial laundries industry, where only pretreatment standards are being considered, EPA compared the POTW removals with removals achieved by indirect dischargers using the candidate technology that satisfies the BAT factors.

For specific pollutants, such as volatile organic compounds or highly biodegradable compounds, EPA may use other means to determine pass through. For volatile compounds, a volatile override test based on the Henry’s Law Constant is used to determine pass through. For this proposed rule, EPA has determined that a pollutant that has a Henry’s Law Constant greater than 2.4 x 10-5 atm-m^3/mole will be sufficiently volatile such that a significant portion of the compound would not be treated by the POTW and therefore is determined to pass through. For highly biodegradable compounds, the pass-through determination may be conducted using engineering modeling.

For this proposed rule, the percent removal comparison between indirect dischargers using the candidate PSES technology and POTWs and the volatile override test were used to determine pass through. Since EPA has not identified any direct dischargers,

Table 7-7

Pollutants Eliminated from Consideration for Regulation for the Industrial Laundries Industry for Chemical Precipitation Options

Pollutant	Reason Excluded
Priority Organics	
1,2-Diphenylhydrazine	Pollutant not detected.
4-Chloro-3-methylphenol	Pollutant detected below treatable concentrations.
Chlorobenzene	Pollutant detected below treatable concentrations.
Chloroform	Pollutant detected below treatable concentrations.
Di-*n*-butyl-phthalate	Pollutant detected below treatable concentrations.
Methylene Chloride	Pollutant detected below treatable concentrations.
Phenol	Pollutant not treated by technology.
trans-1,2-Dichloroethene	Pollutant not detected.
Trichloroethene	Pollutant not detected.
Nonconventional Organics	
2-Propanone	Pollutant not treated by technology.
∝-Terpineol	Pollutant not treated by technology.
Benzoic Acid	Pollutant detected below treatable concentrations.
Benzyl Alcohol	Pollutant not treated by technology.
Hexanoic Acid	Pollutant not treated by technology.
p-Cresol	Pollutant not detected.
p-Cymene	Pollutant not detected.
Pentamethylbenzene	Pollutant not detected.
Priority Metals and Elements	
Antimony	Pollutant detected below treatable concentrations.
Arsenic	Pollutant detected below treatable concentrations.
Beryllium	Pollutant detected below treatable concentrations.
Mercury	Pollutant detected below treatable concentrations.
Nickel	Pollutant detected below treatable concentrations.
Selenium	Pollutant detected below treatable concentrations.
Silver	Pollutant detected below treatable concentrations.
Thallium	Pollutant not detected.

Table 7-7 (Continued)

Pollutant	Reason Excluded
Nonconventional Metals and Elements	
Barium	Pollutant detected below treatable concentrations.
Boron	Pollutant detected below treatable concentrations.
Cobalt	Pollutant detected below treatable concentrations.
Tin	Pollutant detected below treatable concentrations.
Vanadium	Pollutant detected below treatable concentrations.
Yttrium	Pollutant detected below treatable concentrations.

Table 7-8

Pollutants Eliminated from Consideration for Regulation for the Industrial Laundries Industry for Dissolved Air Flotation Options

Pollutant	Reason Excluded
Priority Organics	
1,2-Diphenylhydrazine	Pollutant not detected.
Butyl Benzyl Phthalate	Pollutant detected below treatable concentrations.
Isophorone	Pollutant not detected.
trans-1,2-Dichloroethene	Pollutant detected below treatable concentrations.
Trichloroethene	Pollutant detected below treatable concentrations.
Nonconventional Organics	
Benzyl Alcohol	Pollutant detected below treatable concentrations.
Hexanoic Acid	Pollutant not detected.
p-Cresol	Pollutant detected below treatable concentrations.
Pentamethylbenzene	Pollutant not detected.
Priority Metals and Elements	
Arsenic	Pollutant detected below treatable concentrations.
Beryllium	Pollutant not detected.
Mercury	Pollutant detected below treatable concentrations.
Silver	Pollutant detected below treatable concentrations.
Thallium	Pollutant detected below treatable concentrations.
Nonconventional Metals and Elements	
Barium	Pollutant detected below treatable concentrations.
Boron	Pollutant detected below treatable concentrations.
Cobalt	Pollutant detected below treatable concentrations.
Vanadium	Pollutant detected below treatable concentrations.
Yttrium	Pollutant detected below treatable concentrations.

EPA used PSES percent removals for evaluating pass through. EPA finds that a pollutant passes through when the average percent removed nationwide by well-operated POTWs(those meeting secondary treatment requirements) is less than the average percent removed by facilities meeting the candidate PSES for that pollutant.

EPA eliminated three conventional pollutants, biochemical oxygen demand (BOD), total suspended solids (TSS), and oil and grease (measured as HEM), from further consideration for regulation without conducting the percent removal comparison because POTWs are designed to treat these parameters. EPA does not consider these three conventional pollutants to pass through. For this analysis, EPA evaluated 25 pollutants from the list of 72 pollutants of concern for chemical precipitation and 37 pollutants were evaluated for dissolved air flotation. The POTW removals used in the pass-through analysis are presented in Tables 7-9 and 7-10. The following sections present the methodology and results from the pass-through analysis performed for both the chemical precipitation and DAF.

7.4.4.2 Methodology for Determining Treatment Technology Percent Removals

Treatment performance data for chemical precipitation and dissolved air flotation were obtained during the industrial laundries sampling program. Influent and effluent data for chemical precipitation were obtained from one facility and comparable data for DAF were obtained from two facilities. These data were used to determine whether a pollutant passes through a POTW. For conducting the pass-through analysis, the data were edited as described in Chapter 9 for calculating the long-term average concentrations. This editing included removing data that were associated with treatment or process upsets, removing data for pollutants that were never detected in influents to treatment systems, removing data for pollutants not treated by the treatment technology, and removing data with influent concentrations less than ten times the method detection level and the corresponding effluent data. These editing criteria were used to allow for the possibility that low percent removals reflected low influent concentrations, not treatment technology performance.

After the data were edited, EPA used the following methodology to calculate a percent removal:

1) The remaining influent data and effluent data for a sampled facility were averaged for each pollutant, to give an average influent concentration and an average effluent concentration for each pollutant.

2) EPA calculated percent removals from the average influent and average effluent concentrations for each pollutant for a sampled facility using the following equation:

$$\text{Percent Removal} = \frac{\text{Influent}_{\text{avg}} - \text{Effluent}_{\text{avg}}}{\text{Influent}_{\text{avg}}} \times 100$$

Table 7-9

Comparison of the Chemical Precipitation Treatment Technology and POTW Percent Removals for the Industrial Laundries Pass-Through Analysis

Pollutant	Chem Precip Percent Removal	Percent POTW Removal	Source of POTW Removals	Chem Precip Removal Greater than POTW Removal?	Henry's Law Constant Greater than $2.4x10^{-5}$ atm-m^3/mol?	Pass Through?
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	88	82	50 POTW (10XDL)	Yes	---	Yes
Total Organic Carbon (TOC)	81	71	50 POTW (10XDL)	Yes	---	Yes
TPH (measured as SGT-HEM)	94	65	Average of N-alkanes	Yes	---	Yes
Priority Organics						
1,1,1-Trichloroethane	35	*	*	No	Yes	Yes
Bis(2-ethylhexyl) Phthalate	97	60	50 POTW (10XDL)	Yes	No	Yes
Butyl Benzyl Phthalate	90	86	RREL5 (All WW)	Yes	No	Yes
Di-*n*-octyl Phthalate	94	*	*	Yes	Yes	Yes
Ethylbenzene	50	*	*	No	Yes	Yes
Isophorone	2	62	RREL (Dom WW)	No	No	No
Naphthalene	92	*	*	No	Yes	Yes
Tetrachloroethene	78	*	*	No	Yes	Yes
Toluene	13	*	*	No	Yes	Yes

Table 7-9 (Continued)

Pollutant	Chem Precip Percent Removal	Percent POTW Removal	Source of POTW Removals	Chem Precip Removal Greater than POTW Removal?	Henry's Law Constant Greater than $2.4x10^{-5}$ atm-m^3/mol?	Pass Through?
Nonconventional Organics						
2-Butanone	8	*	*	No	Yes	Yes
2-Methylnaphthalene	96	28	RREL 5 (All WW)	Yes	No	Yes
4-Methyl-2-pentanone	21	*	*	No	Yes	Yes
m-Xylene	78	*	*	Yes	Yes	Yes
o-&*p*-Xylene	61	*	*	No	Yes	Yes
Priority Metals and Elements						
Cadmium	97	91	50 POTW (10XDL)	Yes	---	Yes
Chromium	92	91	50 POTW (10XDL)	Yes	---	Yes
Copper	98	84	50 POTW (10XDL)	Yes	---	Yes
Lead	96	92	50 POTW (10XDL)	Yes	---	Yes
Zinc	98	77	50 POTW (10XDL)	Yes	---	Yes
Nonconventional Metals and Elements						
Manganese	99	41	RREL5 (All WW)	Yes	---	Yes
Molybdenum	22	52	RREL5 (Dom WW)	No	---	No
Titanium	82	69	RREL5 (All WW)	Yes	---	Yes

*Percent removal not calculated because pollutant has a Henry's law Constant greater than 2.4 x 10^{-5} atm-m^3/mol.
50 POTW (10XDL) - 50 POTW Study, using 10 times the method detection level editing criterion
RREL5 (All WW) - RREL Treatability Database Version 5.0, using domestic and industrial wastewater editing criterion
RREL5 (Dom WW) - RREL Treatability Database Version 5.0, using domestic wastewater editing criterion
SGT-HEM - Silica gel treated-hexane extractable material

Table 7-10

Comparison of the DAF Treatment Technology and POTW Percent Removals for the Industrial Laundries Pass-Through Analysis

Pollutant	DAF Percent Removal	Percent POTW Removal	Source of POTW Removals	DAF Removal Greater than POTW Removal?	Henrys Law Constant Greater than $2.4x10^{-5}$ atm-m^3/mol?	Pass Through?
Bulk Nonconventionals						
TPH (measured as SGT-HEM)	98	65	Average of *n*-alkanes	Yes	---	Yes
Chemical Oxygen Demand (COD)	82	82	50 POTW (10XDL)	No	---	No
Total Organic Carbon (TOC)	66	71	50 POTW (10XDL)	No	---	No
Priority Organics						
1,1,1-Trichloroethane	75	*	*	No	Yes	Yes
4-Chloro-3-methylphenol	11	63	RREL5 (All WW)	No	No	No
Bis(2-ethylhexyl) Phthalate	>99	60	50 POTW (10XDL)	Yes	No	Yes
Chlorobenzene	88	*	*	No	Yes	Yes
Chloroform	<1	*	*	No	Yes	Yes
Di-*n*-butyl Phthalate	95	75	50 POTW (>20PPB)	Yes	No	Yes
Di-*n*-octyl Phthalate	91	*	*	Yes	Yes	Yes
Ethylbenzene	94	*	*	No	Yes	Yes
Methylene Chloride	36	*	*	No	Yes	Yes
Naphthalene	93	*	*	No	Yes	Yes
Phenol	3	95	50 POTW (10XDL)	No	No	No
Tetrachloroethene	74	*	*	No	Yes	Yes

Table 7-10 (Continued)

Pollutant	DAF Percent Removal	Percent POTW Removal	Source of POTW Removals	DAF Removal Greater than POTW Removal?	Henrys Law Constant Greater than 2.4×10^{-5} atm-m^3/mol?	Pass Through?
Toluene	48	*	*	No	Yes	Yes
Nonconventional Organics						
2-Butanone	29	*	*	No	Yes	Yes
2-Methylnaphthalene	97	28	RREL 5 (All WW)	Yes	No	Yes
2-Propanone	36	84	RREL 5 (All WW)	No	No	No
4-Methyl-2-pentanone	48	*	*	No	Yes	Yes
∝-Terpineol	25	*	*	No	Yes	Yes
Benzoic Acid	5	81	RREL 5 (All WW)	No	No	No
m-Xylene	95	*	*	Yes	Yes	Yes
o-&*p*-Xylene	66	*	*	No	Yes	Yes
p-Cymene	94	99	RREL5 (All WW)	No	---	No
Priority Metals and Elements						
Antimony	79	72	50 POTW (10XDL)	Yes	---	Yes
Cadmium	87	91	50 POTW (10XDL)	No	---	No
Chromium	92	91	50 POTW (10XDL)	Yes	---	Yes
Copper	91	84	50 POTW (10XDL)	Yes	---	Yes
Lead	92	92	50 POTW (10XDL)	No	---	No
Nickel	87	52	50 POTW (10XDL)	Yes	---	Yes
Selenium	5	34	RREL5 (Dom WW)	No	---	No
Zinc	90	77	50 POTW (10XDL)	Yes	---	Yes

Table 7-10 (Continued)

Pollutant	DAF Percent Removal	Percent POTW Removal	Source of POTW Removals	DAF Removal Greater than POTW Removal?	Henrys Law Constant Greater than $2.4x10^{-5}$ atm-m^3/mol?	Pass Through?
Nonconventional Metals and Elements						
Manganese	92	41	RREL5 (All WW)	Yes	---	Yes
Molybdenum	52	52	RREL5 (Dom WW)	No	---	No
Tin	73	65	RREL5 (All WW)	Yes	---	Yes
Titanium	93	69	RREL5 (All WW)	Yes	---	Yes

*Percent removal not calculated because pollutant has a Henry's Law Constant greater than 2.4×10^{-5}atm-m^3/mol.
50 POTW (10 XDL) - 50 POTW Study, using 10 times the method detection level editing criterion
50 POTW (>20PPB) - 50 POTW Study, using data greater than 20ppb editing criterion
RREL5 (All WW) - RREL Treatability Database Version 5.0, using domestic and industrial wastewater editing criterion
RREL5 (Dom WW) - RREL Treatability Database Version 5.0, using domestic wastewater editing criterion
SGT-HEM - Silica gel treated-hexane extractable material

3) EPA calculated the median percent removal for each pollutant for each technology from the facility-specific percent removals.

7.4.4.3 Methodology for Determining POTW Percent Removals

The primary source of the POTW percent removals data was the Fate of Priority Pollutants in Publicly Owned Treatment Works (50 POTW Study) (2). However, the 50 POTW Study did not contain data for all pollutants for which the pass-through analysis was to be performed. Therefore, EPA obtained additional data from the Risk Reduction Engineering Laboratory (RREL) Treatability Database. Additional information on these sources is presented below. The following priority of data sources was used to determine the percent removal of pollutants by POTWs nationwide:

- 50 POTW Study;
- RREL Treatability Database; and
- Generic pollutant group removal.

7.4.4.4 50 POTW Study

The primary source of the POTW percent removals data was the 50 POTW Study. The POTW data were edited to eliminate influent and the corresponding effluent data where the average influent concentration at a POTW was less than ten times the method detection level edit, to allow for the possibility that low percent removals reflected low influent concentrations, not POTW treatment technology performance. EPA used the method detection levels reported at the time of the 50 POTW Study to edit the data.

In cases where no data remained after conducting the ten times the method detection level edit, EPA used less stringent editing criteria. In these cases, influent data were eliminated where the influent concentrations were less than 20 µg/L or less than the method detection level for pollutants where the method detection level is greater than 20 µg/L. The effluent data corresponding to these influent data were also eliminated. EPA selected 20 µg/L because, for pollutants with low influent concentrations (i.e., less than 20 µg/L or the method detection limit), the effluent concentrations were consistently below the method detection level and could not be precisely quantified.

After the POTW data were edited, the following methodology was used to calculate POTW percent removal:

1) The remaining influent data and effluent data for each POTW were averaged for each pollutant to give an average influent concentration and an average effluent concentration for each pollutant. EPA determined that

the minimum concentration at which a pollutant can be accurately measured is the method detection level. Therefore, if the average effluent concentration was less than the method detection level, EPA set the average effluent concentration to the method detection level before calculating the average effluent concentration.

2) Percent removals were calculated from the average influent and average effluent concentrations for each pollutant for the POTW using the equation in Section 7.4.4.2 of this document.

3) The median percent removal was calculated for each pollutant from the POTW-specific percent removals.

7.4.4.5 RREL Treatability Database

If the POTW percent removal for a pollutant could not be calculated using the 50 POTW Study data, EPA used data from the RREL Treatability Database to determine the POTW percent removal. Because individual influent/effluent pairs were not provided in the database, the data-editing criteria used for the 50-POTW Study could not be used. EPA edited the RREL Treatability Database using the following criteria:

1) Only data pertaining to domestic wastewater were used, unless there were less than three data points available.

2) If there were less than three data points available using the domestic wastewater edit, a combination of domestic wastewater and industrial wastewater data were used.

3) Only full-scale and pilot-scale data were used; bench-scale data were not used.

4) Only data from a peer-reviewed journal, a government report, or a government database were used. However, data from the 50 POTW Study (a government report) reported in the RREL Treatability Database were not used. These data points were not used because if the RREL Treatability Database was being examined, it meant that the data for a pollutant did not meet the editing criteria for the 50 POTW Study, as outlined above.

5) Only data from treatment technologies representing secondary treatment of wastewater were used. These technologies included activated sludge, aerated lagoon, sedimentation followed by activated sludge, and activated sludge followed by activated sludge treatment.

After applying these editing criteria, EPA calculated percent removals for each data source for each pollutant, using the equation in Section 7.4.4.2 of this document. EPA then took the average of the percent removals for each pollutant to obtain an average POTW percent removal from the RREL Treatability Database.

7.4.4.6 Generic Removal

After the editing of the 50 POTW Study and RREL Treatability Database, data for TPH, measured as SGT-HEM, were still not available. In order to determine an appropriate POTW percent removal for this pollutant, the available data for the 72 pollutants of concern were reviewed. EPA determined that the best source of POTW removal data for TPH would be the generic group removal of the *n*-alkanes. EPA determined that because the *n*-alkanes comprise a portion of TPH, the percent removal from these compounds represents the best available percent removal for TPH. Table 7-11 presents the *n*-alkanes removal data used to calculate the percent removal for TPH.

7.4.4.7 Results of the POTW Pass-Through Analysis

Tables 7-9 and 7-10 present a comparison of the treatment technology percent removal with the POTW percent removal for chemical precipitation and DAF, respectively. If the treatment technology percent removal is greater than the POTW percent removal, the pollutant is considered to pass through the POTW. A pollutant with a Henry’s Law Constant greater than 2.4×10^{-5} atm-m^3/mol was determined to pass through regardless of its percent removal. For chemical precipitation, 23 of the 25 pollutants analyzed passed through. For DAF, 26 of the 37 pollutants analyzed passed through.

7.4.5 Selection of Regulated Pollutants

Based on the results of the pass-through analysis, EPA considered the pollutants shown in Table 7-12 as pollutants for regulation under the proposed rule for the chemical precipitation and DAF technologies. To further streamline the list of pollutants for proposed regulation, EPA considered using "indicator" pollutants to reflect control of a broader set of pollutants. Because many of the pollutants originate from similar sources and have similar treatability properties, EPA concluded that indicator pollutants are appropriate for controlling discharges from industrial laundries to POTWs. In selecting indicator pollutants to reflect control of a broader set of pollutants, EPA chose pollutants that were detected most frequently, detected in the higher concentrations, and are most toxic. The following paragraphs describe the rationale for selecting the 11 pollutants for regulation.

EPA considered three bulk parameters, TPH (measured as SGT-HEM), TOC, and COD, for regulation. EPA believes that controlling one bulk parameter in industrial laundries

Table 7-11

Generic Removal for *n*-Alkanes

Pollutant	POTW Removal (%)	Source of Data
n-Decane	9	RREL Treatability Database - Domestic and Industrial Wastewater Edit
n-Dodecane	95	RREL Treatability Database - Domestic and Industrial Wastewater Edit
n-Eicosane	92	RREL Treatability Database - Domestic and Industrial Wastewater Edit
Average Group Removal	**65**	---

Table 7-12

Pollutants Considered for Regulation for Chemical Precipitation and DAF after the Pass-Through Analysis

Chemical Precipitation
Bulk Nonconventionals
Chemical Oxygen Demand (COD)
Total Organic Carbon (TOC)
Total Petroleum Hydrocarbons (measured as SGT-HEM)
Priority Volatile Organics
1,1,1-Trichloroethane
Ethylbenzene
Tetrachloroethene
Toluene
Priority Semivolatile Organics
Bis(2-ethylhexyl) Phthalate
Butyl Benzyl Phthalate
Di-*n*-octyl Phthalate
Naphthalene
Nonconventional Volatile Organics
2-Butanone
2-Methyl-2-pentanone
m-Xylene
o-&*p*-Xylene
Nonconventional Volatile Organics
2-Methylnaphthalene
Priority Metals and Elements
Cadmium
Chromium
Copper
Lead
Zinc

Table 7-12 (Continued)

Chemical Precipitation
Nonconventional Metals and Elements
Manganese
Titanium
DAF
Bulk Nonconventionals
Total Petroleum Hydrocarbons (measured as SGT-HEM)
Priority Volatile Organics
1,1,1-Trichloroethane
Chlorobenzene
Chloroform
Ethylbenzene
Methylene Chloride
Tetrachloroethene
Toluene
Priority Semivolatile Organics
Bis(2-ethylhexyl) Phthalate
Di-*n*-butyl Phthalate
Di-*n*-octyl Phthalate
Naphthalene
Nonconventional Volatile Organics
2-Butanone
4-Methyl-2-pentanone
m-Xylene
o-&*p*-Xylene
Nonconventional Semivolatile Organics
2-Methylnaphthalene
∝-Terpineol

Table 7-12 (Continued)

DAF
Priority Metals and Elements
Antimony
Chromium
Copper
Nickel
Zinc
Nonconventional Metals and Elements
Manganese
Tin
Titanium

SGT-HEM - Silica gel treated-hexane extractable material.

wastewater is sufficient to ensure the appropriate level of control of the effluent from industrial laundries. TPH is a measure of the mineral oil fraction of carbon-containing compounds and mineral oils are treated less effectively by POTWs than many other carbon-containing compounds; therefore, EPA has selected TPH for proposed regulation. Because TPH measures a variety of organic compounds, it can also serve as an indicator pollutant for other organic pollutants shown on Table 7-12.

EPA believes that controlling the following volatile organic pollutants will control the remaining volatile organic pollutants shown on Table 7-12:

- Ethylbenzene;
- Tetrachloroethene;
- Toluene;
- *m*-Xylene; and
- *o*-&*p*-Xylene.

These pollutants represent a cross-section of chlorinated and aromatic compounds that are the majority of the volatile pollutants on Table 7-12. As shown in Table 7-5, these pollutants are detected frequently and at relatively high concentrations.

EPA believes that controlling the following semivolatile organic pollutants will control the remaining semivolatile organic and phthalate pollutants shown on Table 7-12:

- Bis(2-ethylhexyl) phthalate; and
- Naphthalene.

EPA selected these pollutants because they are detected frequently, at relatively high concentrations, and are relatively toxic.

EPA believes that controlling the following metal pollutants will control the remaining metal and elemental pollutants on Table 7-12:

- Copper;
- Lead (Note: lead does not pass through for DAF); and
- Zinc.

These metals were selected because the minimum solubilities of their associated metal hydroxides span a pH range of approximately 7 through 12. Controlling the pollutants within this pH range will also control other metal pollutants of concern. Most metals will be treated by chemical precipitation or dissolved air flotation within this range. These metals were also selected because they were detected most frequently (in nearly 100% of untreated wastewater samples) and in the highest concentrations.

7.5 References

1. U.S. Environmental Protection Agency. List of Lists: A Catalog of Analytes and Methods. 121W-4005. Washington, D.C., August 1991.

2. U.S. Environmental Protection Agency. Fate of Priority Pollutants in Publicly Owned Treatment Works, EPA-440/1-82/303. Washington, DC, September 1982.

3. U.S. Environmental Protection Agency. The Risk Reduction Engineering Laboratory (RREL) Treatability Database. Version 5.0., Cincinnati, OH.

CHAPTER 8

POLLUTION PREVENTION, RECYCLING, TREATMENT, AND DISPOSAL TECHNOLOGIES EMPLOYED BY THE INDUSTRIAL LAUNDRIES INDUSTRY

8.1 Introduction

The Pollution Prevention Act of 1990 and EPA's 1991 Pollution Prevention Strategy established an environmental management hierarchy that includes (in order of highest priority) pollution prevention, recycling, treatment and disposal or release. Presented in this chapter are the pollution control technologies applicable to the industrial laundries industry for each step of the environmental management hierarchy. This chapter presents the following information:

- Section 8.2 discusses the environmental management hierarchy established by the United States Congress and EPA;
- Section 8.3 discusses the pollution prevention measures used in the industrial laundries industry;
- Section 8.4 discusses the pollution recycling measures used in the industrial laundries industry;
- Section 8.5 discusses the major wastewater treatment technologies used by the industry;
- Section 8.6 discusses the pollution disposal measures used by the industrial laundries industry; and
- Section 8.7 presents the references used.

8.2 The Environmental Management Hierarchy

As it applies to industry, the environmental management hierarchy (outlined in Figure 8-1) stipulates that:

- Facilities should reduce pollution at the source whenever feasible;
- Facilities should recycle pollution that cannot be reduced in an environmentally safe manner whenever feasible;
- Facilities should treat pollution that cannot be reduced or recycled in an environmentally safe manner whenever feasible; and

I. Source Reduction

A. Product Changes
1. Design for Less Environmental Impact
2. Increased Product Life

B. Process Changes

1. Input Material Changes
- Material Purification
- Substitution of Less Toxic Materials

2. Technology Changes
- Layout Changes
- Increased Automation
- Improved Operating Conditions
- Improved Equipment
- New Technology

3. Improved Operating Practices
- Operating and Maintenance Procedures
- Management Practices
- Stream Segregation
- Material Handling Improvements
- Production Scheduling
- Inventory Control
- Training
- Waste Segregation

II. Recycling

A. Reuse

B. Reclamation

III. Treatment

IV. Disposal

Reference: United State EPA, Office of Research and Development. Facility Pollution Prevention Guide, EPA/600/R-92/088, May 1992.

Figure 8-1. Environmental Management Options Hierarchy

- Facilities should only dispose or release pollutants into the environment as a last resort. Facilities should conduct this practice in an environmentally safe manner.

EPA examined pollution prevention, recycling, treatment and disposal practices applicable to the industrial laundries industry in an effort to incorporate the environmental management hierarchy into the industrial laundries regulatory options development process. As part of the Industrial Pollution Prevention Project (IP3) (1), a joint effort of EPA, state agencies, local agencies, and industrial laundries, EPA determined that industrial laundries can best identify pollution prevention and recycling opportunities by identifying all sources of pollution at their facilities, including hazardous wastes, solid wastes, air emissions, and water discharges. Then facility personnel and their customers can work together to find solutions which reduce or eliminate the generation of the wastes through source reduction, reuse, and recycling. Specific waste reduction opportunities at industrial laundries identified by EPA during the IP3 will be presented in Sections 8.3 and 8.4 of this document. The information EPA collected on pollution prevention, recycling, treatment and disposal practices as part of the industrial laundries regulatory development process and the IP3 is presented in Sections 8.3 through 8.6 of this document.

8.3 Pollution Prevention/Source Reduction in the Industrial Laundries Industry

Pollution prevention, established as the most desirable option of pollution control in the environmental management hierarchy, is defined as the use of materials, processes, or practices that reduce or eliminate the generation of pollutants or wastes at the source. Also known as source reduction, pollution prevention includes practices that reduce the use of hazardous and nonhazardous materials, energy, water, or other natural resources. End-of-pipe pollution control and waste-handling measures (including waste treatment, off-site recycling, volume reduction (e.g., sludge dewatering), dilution, and transfer of constituents to another environmental medium) are not considered pollution prevention because such measures are applied only after wastes are generated. With the Pollution Prevention Act of 1990, Congress established pollution prevention as a national policy, declaring that the generation of pollutants should be prevented or reduced during the production cycle whenever feasible.

In the 1994 Industrial Laundries Industry Detailed Questionnaire, EPA asked industrial laundries to provide information on the types of pollution prevention activities performed at their facilities. Of the 193 in-scope industrial laundries responding to the detailed questionnaire (in-scope facilities are those that meet the definition of an industrial laundry as presented in Chapter 6, regardless of annual production), 47 industrial laundries reported having a pollution prevention policy (45 of these facilities attached copies of the plans to the questionnaire), and 54 industrial laundries stated that they plan to implement additional pollution prevention activities in the near future.

A total of 105 in-scope industrial laundries reported conducting pollution prevention activities prior to the laundering process (preprocess activities), during the laundering process (in-process activities), or both. The information reported by the facilities for preprocess and in-process pollution prevention activities is presented in Sections 8.3.1 and 8.3.2 of this document.

8.3.1 Preprocess Pollution Prevention Activities

Seventy-nine (79) in-scope industrial laundries responding to the detailed questionnaire reported conducting preprocess pollution prevention activities. Table 8-1 presents the number of industrial laundries, by production category, that reported preprocess pollution prevention activities. EPA analyzed the data in the questionnaire responses to determine if facility size was a factor in the performance of preprocess pollution prevention activities. For each production category, EPA calculated the percentage of industrial laundries that reported these activities by dividing the number of industrial laundries reporting activities by the total number of industrial laundries listed in that production category. As shown in Table 8-1, the performance of preprocess pollution prevention activities does not appear to be related to facility size.

Table 8-2 lists all of the preprocess pollution prevention activities reported by industrial laundries in the detailed questionnaire. The most common preprocess pollution prevention activities reported were the refusal of items with free liquids (68 percent) and the refusal of certain items (52 percent). The items most often refused by the industrial laundries were shop and printer towels. Thirteen industrial laundries reported other preprocess activities, including centrifugation of items to remove liquids, dry cleaning of items before water washing, presorting of items to remove trash/objects, and steam/air stripping of volatiles from items. During the IP3, EPA identified preprocess pollution prevention practices that could be implemented by industrial laundries. In addition to the preprocess pollution prevention activities already presented in this section, EPA determined that industrial laundries could reduce the amount of solid waste generated at their facilities by having laundering/dry cleaning/wastewater treatment chemicals shipped to the facilities in bulk containers or in drums that could be returned to the chemical manufacturers.

Facilities responding to the detailed questionnaire reported initiating preprocess pollution prevention activities primarily in the late 1980s and early 1990s. However, several facilities initiated refusal of certain items and the refusal of items with free liquids many years before (the late 1950s and early 1980s, respectively). Facilities that reported these two practices tended to refuse the same items, as shown in the following table:

Items refused	Percentage of Facilities Refusing Items	
	Facilities Refusing Items with Free Liquids	Facilities Refusing Certain Items
Shop towels	48%	27%
Printer towels	28%	32%
Industrial garments	15%	12%

Table 8-1

Number of Industrial Laundries, by Production Category, Reporting Preprocess Pollution Prevention Activities in the Detailed Questionnaire

Production Category (lb/yr)	Number of Facilities Reporting Activities	Total Number of Facilities in Production Category	Percentage of Facilities Reporting Activities in Production Category	Total Production for Facilities Reporting Activities (lb/yr)	Percentage of Total Production for Facilities Reporting Activities
< 1,000,000	9	20	45%	5,810,000	1%
1,000,000 to < 3,000,000	14	39	36%	27,900,000	6%
3,000,000 to < 6,000,000	23	58	40%	102,000,000	21%
6,000,000 to < 9,000,000	17	33	52%	123,000,000	25%
9,000,000 to < 15,000,000	10	25	40%	115,000,000	23%
≥ 15,000,000	6	18	33%	118,000,000	24%
Total	79	193	---	492,000,000	100%

Table 8-2

Types of Preprocess Pollution Prevention Activities Reported in the Detailed Questionnaire

Activity	Number of Facilities Performing Activity	Percentage of Total Number of Facilities Reporting Pre-Process Activities[1]
Refusal of Items with Free Liquids	54	68%
Refusal of Certain Items	41	52%
Centrifugation of Items to Remove Liquids	6	8%
Steam/Air Stripping of Volatile Organics from Items	2[2]	3%
Items Presorted to Remove Objects	3	4%
Items Dry-Cleaned Before Water Washing	5[3]	6%

[1]Percentages are based on 79 industrial laundries that reported preprocess activities.
[2]One of these facilities reported steam/air stripping of volatile organics from items; however, the particular activities reported at this facility do not meet the definition of steam/air stripping.
[3]One additional facility dry cleans items before water washing, but the industrial laundry did not include this information in its detailed questionnaire. EPA obtained this information during a site visit to the facility.

Of the six facilities (in Table 8-2) that reported centrifugation to remove liquids, four performed this activity on shop or printer towels. Likewise, both of the facilities that reported steam/air stripping of volatile organics from items also performed this activity on shop or printer towels. None of the facilities that presorted items to remove trash/objects or dry cleaned items before water washing reported performing these activities on shop or printer towels.

In the detailed questionnaire, EPA asked facilities to report whether performing preprocess pollution prevention activities had a negative impact on the quality of their service. The facilities reported a negative impact most frequently for steam/air stripping of volatile organics from items (100 percent), the refusal of items with free liquids (65 percent), and the refusal of certain items (54 percent). These negative impacts generally included the following:

- Increased burden and costs for the facility (e.g., training of customers, installation of equipment);
- Increased burden and costs for the customers (e.g., purchase of equipment, restricted use of certain items, payment of penalty fees);
- Delayed service; and
- Loss of business/limits to growth.

EPA collected analytical data on two preprocess pollution prevention technologies, dry cleaning prior to waterwashing and steam stripping (steam tumbling), during site visit and sampling activities. Section 8.3.12 discusses these technologies and their application in the industry in more detail.

8.3.2 In-Process Pollution Prevention Activities

Fifty (50) industrial laundries reported conducting in-process pollution prevention activities. Table 8-3 presents the number of industrial laundry facilities, by production category, that reported in-process pollution prevention activities. EPA analyzed the data in the questionnaire database to determine if facility size was a factor in the performance of in-process pollution prevention activities. For each production category, EPA calculated the percentage of facilities that reported activities by dividing the number of facilities reporting activities by the total number of facilities listed in that production category. As shown in Table 8-3, the performance of in-process pollution prevention activities does not appear to be related to facility size.

Table 8-4 lists all in-process pollution prevention activities reported by industrial laundries. The most common types of in-process pollution prevention activities reported by the industrial laundries were:

Table 8-3

Number of Industrial Laundries, by Production Category, Reporting In-Process Pollution Prevention Activities in the Detailed Questionnaire

Production Category (lb/yr)	Number of Facilities Reporting Activities	Total Number of Facilities in Production Category	Percentage of Facilities Reporting Activities in Production Category	Total Production for this Category for Facilities Reporting Activities (lb/yr)	Percentage of Total Production for Facilities Reporting Activities
< 1,000,000	5	20	25%	3,280,000	1%
1,000,000 to < 3,000,000	13	39	33%	23,000,000	7%
3,000,000 to < 6,000,000	14	58	24%	62,300,000	20%
6,000,000 to < 9,000,000	10	33	30%	76,700,000	25%
9,000,000 to < 15,000,000	4	25	16%	51,100,000	17%
≥ 15,000,000	4	18	22%	93,100,000	30%
Total	50	193	---	310,000,000	100%

Table 8-4

Types of In-Process Pollution Prevention Activities Reported in the Detailed Questionnaire

Activity	Number of Facilities Performing Activity	Percentage of Total Number of Facilities Reporting In-Process Activities[1]
Improved Training of Employees	19	38%
Change in Laundering/Dry Cleaning Chemicals Used	20	40%
Liquid Injection System for Wash Chemical Addition	18	36%
Improved Housekeeping	10	20%
Water Softening	6	12%
Equipment Modifications/Installations	3	6%
Recycling of Laundry Materials	1	2%
Removal of Lint Before Air Venting to Atmosphere	1	2%
Reduced Fuel Consumption	1	2%

[1]Percentages are based on 50 industrial laundries that reported in-process pollution prevention activities.

- A change in the use of laundering/dry-cleaning chemicals (40 percent);
- Improved training of employees (i.e., chemical safety, proper handling of equipment) (38 percent); and
- Installation of a liquid injection system to add wash chemicals (36 percent).

A smaller number of facilities reported other in-process activities (improved housekeeping, water softening, implementation of water reuse/reduction, equipment modifications/installations, recycling of laundry materials, removal of lint before air venting to atmosphere, and reduced fuel consumption). During the IP3, EPA identified in-process pollution practices that could be implemented by industrial laundries. In addition to the in-process pollution prevention activities already presented in this section, EPA determined that industrial laundries could also implement the following in-process practices.

- Use calcium extracted from incoming water during water softening to replace the lime used in wastewater treatment/sludge dewatering operations;
- Separate non-hazardous and hazardous waste streams;
- Improve standard operating procedures;
- Establish an inventory control system;
- Perform routine and preventative maintenance on facility equipment;
- Incorporate a paper recycling program;
- Utilize waste exchange programs; and
- Reuse solvent from dry-cleaning operations.

Facilities responding to the detailed questionnaire reported initiating most in-process pollution prevention activities primarily in the late 1980s and early 1990s. However, one facility reported initiating improved training of employees in 1983.

All of the in-process pollution prevention activities reported by the facilities reduce pollution and reduce operating costs by optimizing facility operations. The installation of alternative washers and automated liquid injection systems for washers, the use of alternative washing chemicals, the use of water softening, and the implementation of water reuse/reduction all can reduce the amount of water and/or chemicals that a facility uses. A significant number of facilities have improved employee training and housekeeping standards; these activities can also decrease water and chemical use. In addition, changes in laundering chemicals were reported to improve treatability of the wastewater by forming less refractory emulsions.

In the detailed questionnaire, EPA asked facilities to report whether performing pollution prevention activities had a negative impact on the quality of their service. While most of the industrial laundries reported no negative impacts for the in-process activities, several facilities did report a negative impact on their quality of service for in-process pollution prevention activities. These negative impacts generally included the following:

- Increased burden and costs for the facility (e.g., training of employees, purchase of more expensive liquid chemicals, installation of equipment/ processes, disposal of recovered materials);

- Increased costs to the customers (e.g., increased facility costs were passed on to customers); and

- Decreased quality of service (e.g., graying of clothes).

The in-process pollution prevention activities were more widely practiced on the different items laundered than were the preprocess pollution prevention activities. Since most of the in-process activities affect all washing operations, this wide distribution among all of the item types is to be expected. For example, in-process activities such as liquid injection usually apply to all laundry operations and item types at a facility.

8.4 Pollution Recycling/Resource Conservation and the Industrial Laundries Regulatory Development Process

As established in the environmental management hierarchy, pollution that cannot be prevented or reduced in an environmentally safe manner should be recycled whenever feasible. Pollution recycling conducted in an environmentally safe manner shares many of the advantages of pollution prevention/source reduction. Pollution recycling helps to conserve natural resources, such as energy and water. In addition, pollution recycling reduces the need for end-of-pipe treatment or disposal, the two least desirable pollution control measures in the environmental management hierarchy.

During the IP3, EPA determined that most industrial laundries are taking advantage of opportunities to conserve energy through heat exchange. But, EPA determined that many industrial laundries do not recycle any process water. As part of the industrial laundries regulatory development process, EPA asked industrial laundries receiving the detailed questionnaire and the 1993 Screener Questionnaire for the Industrial Laundries Industry to provide information on the types of pollution recycling/resource conservation activities performed at their facilities. The information reported by the facilities for water reuse and energy reuse is summarized in Sections 8.4.1 and 8.4.2 of this document.

8.4.1 Wastewater Conservation in the Industrial Laundries Industry

Industrial laundries have a variety of opportunities to recycle/reuse water at their facilities. Industrial laundries can recycle or reuse the following sources of water used at the facility as process water or cooling water: laundry wastewater before treatment, laundry wastewater after treatment, noncontact cooling water, contact cooling water, and nonlaundry wastewater.

Forty-six of the 193 in-scope industrial laundries responding to the detailed questionnaire (24 percent) reported recycling a portion of the water used by the facility as process makeup water. Twenty-seven of these facilities (59 percent) reported reusing noncontact cooling water as process makeup water. Twenty facilities (43 percent) reported recycling/reusing laundry wastewater back into the water-washing process before the wastewater had been treated. One of these facilities reported reusing the final rinse from the water-washing process as noncontact cooling water. The noncontact cooling water was then reused at the first rinse in the water-washing process. Eight facilities (19 percent) reported recycling/reusing laundry wastewater back into the water-washing process after the wastewater had been treated. One facility (2 percent) reported reusing nonlaundry wastewater as laundry process water. This facility did not specify the source of the nonlaundry wastewater. No facilities responding to the detailed questionnaire reported reusing contact cooling water.

8.4.2 Energy Conservation in the Industrial Laundries Industry

EPA asked facilities to indicate in the screener questionnaire whether they conserve energy by operating a heat reclaimer. 663 of the 1500 facilities responding to the screener questionnaire (44 percent) reported operating a heat reclaimer at their facility.

8.5 Wastewater Treatment Technologies in the Industrial Laundries Industry

As established in the environmental management hierarchy, pollution that cannot be prevented or recycled in an environmentally safe manner should be treated whenever feasible. This section describes major wastewater treatment technologies used in the industrial laundries industry, based on responses to the detailed questionnaire. Sections 8.5.1 through 8.5.14 describe the wastewater treatment technologies used in the industry. These treatment technologies include:

- Gravity settling (Section 8.5.1);
- Stream splitting (Section 8.5.2);
- Screening (Section 8.5.3);
- Equalization (Section 8.5.4);
- Chemical emulsion breaking (Section 8.5.5);
- Chemical precipitation (Section 8.5.6);
- Dissolved air flotation (DAF) (Section 8.5.7);
- Sludge dewatering (Section 8.5.8);

- pH adjustment (Section 8.5.9);
- Ultrafiltration (Section 8.5.10);
- Centrifugation (Section 8.5.11);
- VOC removal technologies (Section 8.5.12);
- Oil/water separation (Section 8.5.13); and
- Media filtration (Section 8.5.14).

Each technology section includes a general description of how the technology works, the types of pollutants the technology treats, and the application of the technology in the industrial laundries industry as of 1993. Table 8-5 presents the total number of facilities (out of 193 in-scope facilities responding to the detailed questionnaire) that reported using each of these technologies.

8.5.1 Gravity Settling

General Description

Gravity settling, or sedimentation, is primarily used to remove suspended solids from industrial laundry process wastewater. The wastewater is typically collected in a catch basin where the water is detained for a period of time, allowing solids with a higher specific gravity to settle to the bottom of the tank and solids with a lower specific gravity to float to the surface. The effectiveness of solids settling depends upon the characteristics of the laundry wastewater and the length of time the wastewater is held in the catch basin. Properly designed and operated settling tanks are capable of achieving significant reductions of suspended solids and 5-day biochemical oxygen demand (BOD_5) (2).

The solids that settle out or float to the surface may be removed from the basin continuously using automated rakes or augers that scrape the solids into a collection unit for subsequent dewatering or disposal. Alternatively, the basins may be periodically shut down and the solids pumped out and collected for disposal.

Industry Application

Although only fifty-one percent of in-scope industrial laundries responding to the detailed questionnaire (98 of 193) reported treating their wastewater through gravity settling, every facility visited by EPA has a settling basin in place at their facility. Therefore, EPA believes all industrial laundries have settling basins in place at their facilities and can incorporate gravity settling and solids removal as part of their treatment train without modification of their wastewater treatment equipment. All 98 facilities reporting the use of gravity settling also report removing sludge from the gravity settling unit. The gravity settling units used at these 98 facilities have an average residence time of 2.3 hours. Ten industrial laundries add chemicals to their gravity settling unit, most frequently sulfuric acid (added by 6 facilities) and polymer (added by 2 facilities).

Table 8-5

Number of Facilities Responding to Detailed Questionnaire Using Wastewater Treatment Technologies

Technology	Number of Facilities Using Technology	Percentage of Total Number of Industrial Laundries Responding to the Detailed Questionnaire[1]
Gravity Settling	98	51%
Stream Splitting	20	10%
Screening	146	76%
Equalization	147	76%
Chemical Emulsion Breaking	11	6%
Chemical Precipitation	19	10%
Dissolved Air Flotation	36	19%
Sludge Dewatering	59	31%
pH Adjustment	42	22%
Ultrafiltration	2	1%
Centrifugation	4	2%
VOC Removal Technologies	12	6%
Oil/Water Separation	28	15%
Media Filtration	10	5%

[1]Percentages are based on the 193 in-scope industrial laundries that responded to the detailed questionnaire.

8.5.2 Stream Splitting

General Description

Segregating process wastewater streams provides a means of treating a portion of the total process wastewater generated at industrial laundries. Stream splitting may be used to isolate and treat a stream with a high pollutant load, while a stream with a lower load is either recycled and reused or discharged directly to the publicly owned treatment works (POTW) without treatment. This segregation allows a facility to install a smaller treatment system than would be necessary if the total process wastewater stream was treated. In addition, facilities can reduce overall process water use if they can recycle or reuse the less concentrated streams.

A divided trench and sump system is used to split process wastewater streams. This system is installed as two completely separate trenches and/or sumps, or an existing system may be modified to accommodate two separate wastewater streams. One modification to an existing system entails placing a dividing wall down the center of the existing trench and/or sump. This wall may be constructed of concrete, coated metal plates, or other impervious material. Alternatively, one stream may be hard piped to a specific treatment unit or collection tank while the other stream flows through the existing trench and sump. Pipe made of polyvinyl chloride (PVC) is generally used because of its compatibility with industrial laundry process wastewater pH and temperatures. Facilities often need to install additional collection tanks and transfer pumps to accommodate the two process wastewater streams (3).

In addition to the facility's process wastewater trench and sump system being split, the washer, extractor, and/or washer-extractor machines must either be capable of releasing process wastewater into separate conduits or be used as dedicated machines for washing a specific item or group of items so the wastewater discharge can be directed to the appropriate trench. Machines can be purchased having multiple water discharge ports and control valves to allow each process break or rinse to be released to a separate location according to the wash formula. For example, the operator may program the washer/extractor to release the initial wash breaks containing the dirtier water to the treatment system to be treated and discharged, while routing the final rinses to a storage tank to be recycled and used in subsequent washing processes or to be discharged without treatment. Existing machines that do not currently have this capability can be retrofitted with control and discharge valves to enable them to divert the wastewater. Another method of segregating process wastewater is to identify items that generate the more polluted water and those that generate cleaner water. The facility may then designate certain machines to wash a specific group of items and direct all of the process wastewater from those machines to the desired location.

Industry Application

Ten percent of in-scope industrial laundries responding to the detailed questionnaire (20 of 193) reported segregating their process wastewater streams to treat a portion of the total process wastewater generated at their facilities. One additional facility responding to the detailed questionnaire reported having the capability to segregate its process wastewater stream but did not report treating any portion of this process wastewater.

8.5.3 Screening

General Description

Wastewater is often screened prior to subsequent treatment to remove grit and suspended solids that may potentially damage or clog process equipment located downstream. Coarse screening is often performed using a bar screen, constructed of flat steel bars welded together in a grid pattern. The bar screen is designed to allow free flow of effluent while removing large objects from the wastewater stream (4). Bar screens can be automatically or manually cleaned to remove the entrapped objects. If performed on a regular basis, manually cleaned bar screens are often the most cost-efficient (5).

Fine screening is performed using lint screens. These screens are constructed of wire mesh or perforated metal plates and are often installed downstream from bar screens. Lint screens are designed to remove lint and other particles, such as sand or grit, from wastewater (4). Hydrosieve or static screens are installed in the process wastewater line and trap the entrained particles as the water passes through the screen. Static screens must be routinely cleaned or changed out to prevent excessive clogging of the wastewater line. This task is often performed manually. The static screen is relatively inexpensive to maintain and operate.

Shaker and rotary screens are mechanically equipped to remove the entrained solids from the screen apparatus to ensure continuous operation. Shaker or vibratory screens operate by intermittently vibrating about the center of mass, forcing the solids from the screen surface, outward toward the periphery, and around to a port through which the solids are removed and collected in a sack or bin. These screens may also include accessories, such as brushes, rakes, and water sprayers, to remove solids and to enhance the performance of the continuous screen cleaning mechanism (6). Figure 8-2 presents a diagram of a shaker screen.

A rotary screen consists of a circular screen that rotates within a chamber. The wastewater passes through the screen as it rotates and the solids are collected on the surface of the screen. The solids are removed from the screen surface by means similar to those of shaker screens (i.e., brushes or water sprays). The rotary screen can be operated either by passing the water from the outside of the rotating screen toward the center of the chamber, with solids collection on the exterior surface, or by passing the wastewater from the center of the chamber toward the exterior, with solids collection on the interior surface of the screen (2).

Most screens are placed at the beginning of the wastewater treatment train. Bar screens, in particular, are most often located at the end of the wastewater trenches that carry the water discharged from the wash room to the treatment system (if present) and the final discharge point. As stated in Section 8.5.1, EPA believes that all facilities have an initial catch/settling basin located at the end of the trench. Fine screening (either static or mechanical) may be performed either before or after the water is collected in the catch basin. The advantage to screening the water before initial collection is that the amount of solids that will settle and accumulate within the catch basin is reduced, lowering the maintenance costs associated with periodic cleaning of the catch basin.

Industry Application

The majority of in-scope industrial laundries (76 percent) perform at least one screening operation before discharging their wastewater (146 out of 193 in-scope facilities responding to the detailed questionnaire reported having a screen(s)). Twenty-six facilities perform coarse screening only, using a bar screen.

Forty-three facilities reported at least one type of static screen (e.g., lint screen, box screen, or strainer). The most prevalently used fine screen is the lint screen (reported by 38 facilities); box screen and strainer use was reported much less frequently.

More than half (67 percent) of the facilities reporting a screening operation have at least one mechanical screen. Ninety-two facilities reported having a shaker screen, six facilities reported having a rotary screen, and one facility reported having both types of mechanical screens.

Five facilities use coarse screening with a static fine screen; six facilities use coarse screening with a mechanical fine screen; six facilities use both static and mechanical fine screening; and two facilities use all three types of screens: coarse, static fine, and mechanical fine screening.

8.5.4 Equalization

General Description

Equalization is used to control fluctuations in flow and pollutant loadings in process wastewater prior to treatment to overcome operational problems that may result from the fluctuations, reduce the size and cost of the downstream treatment units, and improve the overall performance of these units. Equalization systems are typically designed to eliminate variations in the wastewater, (e.g., flow, pollutant load, and pH) by retaining the wastewater until it can be discharged at a constant rate having uniform characteristics. In this way, facilities can size and operate the downstream treatment units on a continuous-flow basis with minimal disruption in the treatment conditions. The amount of time required to achieve optimum effects depends upon the specific characteristics and daily flow patterns of the wastewater. Equalization units are often equipped with agitators (e.g., impeller mixers and air spargers) to further mix the wastewater and to prevent excessive solids from settling at the bottom of the unit. Chemicals may also be added to the equalization units to adjust the pH and otherwise prepare the wastewater for further treatment (7). Section 8.5.9 (pH Adjustment) discusses equalization units that use pH-adjusting chemicals.

Industry Application

Seventy-six percent of the in-scope industrial laundries responding to the detailed questionnaire (147 of 193) reported treating their wastewater through equalization. None of these facilities reported adding chemicals to their equalization units. None of the facilities treating their wastewater through equalization reported collecting solids from the equalization unit. The majority (66 percent) of the facilities treating their wastewater through equalization reported using at least one mixer to agitate the wastewater. The equalization units reported in the detailed questionnaire have an average residence time of 7.6 hours.

8.5.5 Chemical Emulsion Breaking

General Description

Chemical emulsion breaking is used primarily to remove oil and grease, as well as other related pollutants, from process wastewater streams. Chemical emulsion breaking is effective in treating wastewater streams having stable oil-in-water emulsions. In a stable emulsion, oil is dispersed within the water by way of attractive electrical charges that exist, often as a result of other constituents (e.g., emulsifying agents and surfactants) present in the water. These emulsions require acid addition to lower the pH of the wastewater and neutralize the electrical charges between the oil and water, enabling the oil to form a distinct and separate phase within the water. Chemical emulsion breaking units add demulsifying agents to aid in forming the oil phase and subsequently remove it from the wastewater stream.

Various reactive cations are effective as demulsifying agents to break emulsions (e.g., hydrogen (H +1), aluminum (Al +3), and iron (Fe +3)). Sources of these cations include acids, alum, ferrous salts, and various cationic polymers. The demulsifier is added to the wastewater stream and allowed to react with the water long enough to cause the oil to agglomerate to form a distinct oil phase. Mechanical mixing increases the effectiveness of the demulsifier by dispersing the chemical into the water rapidly and uniformly. Mixing also aids demulsification by causing molecular collisions that help agglomerate droplets and subsequently help to break the emulsion.

In batch-mode units, the treated wastewater is allowed to stand long enough to allow the oil droplets, having a lower specific gravity, to rise and form a layer on the surface. This layer may be removed by controlling the water level within the unit, such that the oil layer is raised above a weir and overflows into the collection unit while water underflows the weir. The oil layer may also be removed by manually or mechanically raking the surface over a weir with a skimming device.

Skimming devices typically work by continuously contacting the oil with a material, usually an oleophilic belt or rope, onto which the oil readily adheres. As the material passes through the oil layer, the oil coats the surface of the material. The oil-coated material then passes through a mechanism that scrapes the oil from the material into an oil-collection unit. This process uses a motorized drive to continuously remove oil from the wastewater surface. Figure 8-3 presents a diagram of a batch chemical emulsion breaking unit. Batch chemical emulsion breaking systems can remove significant amounts of oil and grease from process wastewater, if they are designed with optimized residence times and the oil-removal devices are properly operated and maintained.

Continuous chemical emulsion breaking units are equipped with various hydrodynamic structures that physically separate entrained oil droplets from wastewater and pump them to a collection unit while allowing the water to pass through without interruption. These units usually comprise a series of corrugated and/or inclined plates arranged parallel to one another and transverse to the flow of water. They are often built of materials that attract oil away from the water. As the oil droplets impinge on the surfaces of the plates, they coalesce into a layer of oil that flows or is pumped from the unit. Figure 8-4 presents a diagram of a continuous chemical emulsion breaking unit with coalescing plates.

Continuous chemical emulsion breaking units do not require long residence times, as do batch systems, and thus are more compact and space efficient. However, they do require uniform wastewater conditions in terms of flow rate and oil and grease loads, which may not be easily achieved in some wastewater treatment systems. In addition, the plates often require routine maintenance to ensure proper operation and to prevent clogging. The effectiveness of batch or continuous systems is highly dependent upon the specific characteristics of the process wastewater (8).

Industry Application

Eleven of the 193 in-scope industrial laundry facilities responding to the detailed questionnaire reported treating their wastewater through chemical emulsion breaking and adding acid as a demulsifying agent. Rope skimmers are used most frequently (at 5 of the facilities) to collect the demulsified oil from the surface of wastewater. Eight facilities demulsify the oil in a batch process with a median residence time of six hours. The remaining three facilities run chemical emulsion breaking continuously, using coalescing plates or plate separators. These continuous-process chemical emulsion breaking units have a much lower median residence time (less than one hour). Eight of the facilities demulsify all of their process wastewater, and three demulsify only heavy wastewater (the portion of the wastewater with the highest concentration of contaminants). Chemical emulsion breaking is often used as a pretreatment to other technologies; six of the eleven facilities reported using chemical emulsion breaking as a pretreatment to either dissolved air flotation (three facilities) or chemical precipitation (three facilities). Ten of the eleven facilities that use chemical emulsion breaking reported disposing of the demulsified oil at an oil reclaimer.

8.5.6 Chemical Precipitation

General Description

Chemical precipitation is one of the most commonly used processes in water treatment (9). Specifically, chemical precipitation is used to remove organics, oils, and dissolved pollutants from process wastewater. Precipitation aids, such as lime, work by reacting with the cations (e.g., metals) and some anions to convert them into an insoluble form (e.g., metal hydroxides). The pH of the wastewater affects how much pollutant mass is precipitated, as various pollutants will precipitate only within specific pH ranges. Therefore, the pH of the wastewater is often increased to facilitate maximum pollutant precipitation. Lime and other caustic materials increase the pH of the wastewater stream and react with the dissolved ions to form insoluble compounds, making them good precipitation aids (8).

In chemical precipitation units, coagulation and flocculation aids are usually added to facilitate the formation of large agglomerated particles that are simpler to remove from the wastewater. The precipitants as well as other suspended solids often have like or neutral surface charges that repel one another. Coagulants bind to the particles in the wastewater stream and essentially convert the surface charges; as a result, opposite charges form between the particles, which causes them to agglomerate. Examples of coagulants include cationic polymers and various inorganic salts, such as ferric chloride ($FeCl_3$), and aluminum sulfate or alum ($Al_2(SO_4)_3 * 18\ H_2O$). Flocculent aids, typically anionic polymers, are added to further enhance the agglomeration of the particles (7).

Like chemical emulsion breaking units, chemical precipitation units may use various mechanisms to remove the agglomerated floc from the wastewater. In batch chemical precipitation systems, the treated wastewater is held in the unit long enough to allow the solids to settle out. The water is then pumped from the unit, and the resulting sludge is removed for further dewatering and subsequent disposal. Figure 8-5 presents a diagram of a batch chemical precipitation system. In a batch system, chemical addition and residence time are easily adjusted based on the particular conditions of the process wastewater. Batch systems usually require the use of two water-holding units connected in parallel (i.e., one is used to treat the process wastewater while the other collects the wastewater to be treated in the next batch) and therefore generally require more space than continuous systems.

Continuous units often use hydrodynamic structures that push the solids downward as the water flows past. These structures usually comprise a series of parallel plates arranged tangentially to the flow of water. As the water flows between them, the heavy particles impinge against the plates and lose enough momentum that they are forced to sink to the bottom of the unit. Continuous units also include pumps or augers that remove the settled solids from the unit. Because of their single unit design and relatively short required retention time, continuous chemical precipitation units are space efficient. However, the performance of continuous systems can be disrupted if wastewater conditions are varied. Figure 8-6 presents a diagram of a continuous chemical precipitation system.

Industry Application

Ten percent of the in-scope industrial laundry facilities responding to the detailed questionnaire (19 of 193) reported treating their wastewater using chemical precipitation. These can be divided into two groups: facilities that use chemical precipitation to treat their entire wastewater stream (14 facilities) and facilities that use chemical precipitation to treat only a portion of the wastewater stream generated from laundering of heavily soiled items such as shop towels (5 facilities).

Chemicals added during chemical precipitation include lime, anionic polymers, and cationic polymers. Facilities using chemical precipitation fall into two categories, or "schemes", depending on the chemicals added during chemical precipitation. The following table shows the distribution of facilities within each scheme that either treat only the portion of their wastewater stream generated from laundering heavily soiled items or their entire wastewater stream.

Scheme	Chemicals Added	Number of Facilities Treating Only Heavy Waste Stream	Number of Facilities Treating Entire Waste Stream
Scheme A	Polymer, lime	4 (21%)	4 (21%)
Scheme B	Polymer	1 (5%)	10 (53%)

All 19 facilities using chemical precipitation reported operating a continuous treatment unit. No facilities reported batch chemical precipitation operation.

8.5.7 Dissolved Air Flotation (DAF)

General Description

Dissolved air flotation (DAF) is used to remove suspended solids, emulsified oil, and some dissolved pollutants from process wastewater. DAF treatment involves coagulating and agglomerating the solids and emulsified oil and floating the resulting floc to the surface using pressurized air injected into the unit. During this process, chemicals such as ferric and aluminum salts, activated silica, and cationic polymers are typically added to alter the repellant surface charges of the particles in the wastewater and cause them to agglomerate (4). Certain dissolved pollutants (e.g., metals) may be precipitated by reacting with the inorganic salts to form insoluble particles that also agglomerate with the floc. Flocculent aids (typically anionic polymers) are also added to DAF treatment systems to further enhance the formation of large particles.

DAF uses a dissolved air stream injected into the bottom of the unit to provide the flotation mechanism. Air is injected into a water tank under sufficient pressure to dissolve the air within the water. As the water is injected into the DAF unit, the pressure is decreased and the air is brought out of solution, creating many small bubbles. The large floc particles attach to the rising bubbles and are brought to the surface of the unit. Injected air flotation (IAF) systems (also referred to as induced air flotation) work in a similar fashion, but do not use pressurized air. Instead, the air is injected directly into the IAF unit. DAF units use rakes that scrape the floc from the surface and into a sludge collection vessel, where it is subsequently pumped to a dewatering unit and later disposed of. Some solids are expected to settle to the bottom of the unit; therefore, some units also have bottom sludge removal rakes or augers (4).

DAF has been applied extensively in the water treatment industry. Specifically, DAF is used to remove fat, oils, fibers, and grease from wastewater and algae from nutrient-rich reservoir water. DAF is commonly used to treat water when sedimentation treatment proves ineffective. Water with low turbidity or low alkalinity or colored water may not be effectively treated through sedimentation. DAF units are typically operated on a continuous basis and incorporate the chemical mix tanks, flotation vessels, and sludge collection into a single unit. Figure 8-7 presents a diagram of a DAF unit.

Industry Application

Nineteen percent of the in-scope industrial laundry facilities responding to the detailed questionnaire (36 of 193) reported treating their wastewater using DAF. All of these facilities add chemicals to the DAF and collect the DAF float sludge. (Four additional facilities that reported using DAF were excluded because they do not add chemicals or collect float sludge.) In addition, 10 of the facilities reported that they also collect bottom sludge.

Chemicals added to the DAF unit include sulfuric acid, inorganic coagulants (metal salts), anionic polymers, cationic polymers, and flocculents. Facilities using DAF fall into four categories, or "schemes", depending on the chemicals added during treatment:

Scheme	Chemicals Added	Number of Facilities Treating Waste Stream
Scheme A	Polymer, inorganic coagulant (metal salt)	14 (39%)
Scheme B	Polymer	14 (39%)
Scheme C	Polymer, flocculent	5 (14%)
Scheme D	Polymer, flocculent, metal salts	3 (8%)

Thirteen facilities also add sulfuric acid to the wastewater before it enters the DAF unit.

8.5.8 Sludge Dewatering

General Description

Sludge dewatering processes remove water from sludge that is generated from the wastewater treatment process. Sludge dewatering provides the following benefits to a facility's operations:

- Substantially reduces the costs for sludge disposal by reducing the sludge volume;
- Allows for easier handling than thickened or liquid sludge; dewatered sludge may be transported via manual shoveling, tractors fitted with buckets and blades, and belt conveyors;
- Reduces the requirements for supplemental bulking agents or amendments added to sludge prior to composting;
- May be a requirement for sludge disposal to render the sludge odorless and nonputrescible; and
- May be a requirement for landfill disposal of sludge to reduce leachate production at the landfill site (2).

Dewatering may involve simple techniques, such as natural evaporation or drying of sludge using heat. Various mechanical techniques may also be used to remove water from sludge more rapidly, such as filtration, squeezing, capillary action, vacuum withdrawal, and centrifugal separation and compaction (2). The two most prevalent mechanical dewatering devices reported in the industrial laundries industry are the rotary vacuum filter and the plate and frame filter press.

The rotary vacuum filter is a cylindrical drum with a filter medium (e.g., natural fiber cloth or screen) around its perimeter. The drum is horizontally suspended within a vessel and is partially submerged in the sludge. The drum is rotated and the drum filter surface contacts the sludge within the vessel while a vacuum is drawn from within. This draws the water through the filter medium from the outside of the drum toward the axis of rotation and discharges it through a filtrate port. The solids become trapped against the filter medium, forming a dewatered filter cake around the outside of the drum. Rotary vacuum filters typically include a knife or a blade, which continuously scrapes the dewatered cake from the outside of the drum and into a collection bin. These types of filters can obtain a reasonably dry cake appropriate for disposal;

however filter aid materials (e.g., diatomaceous earth or perlite) are usually required to precoat the filter (2). Figure 8-8 presents a diagram of a rotary vacuum filter.

Filter presses use positive pressure to drive the water through the filter medium. This type of unit comprises a series of recessed plates affixed with a filter medium (e.g., filter cloth) that are stacked together horizontally on a frame. During operation, the plates are forced together by a hydraulic ram or powered screw. The plates form a series of spaces separated by the filter medium and are otherwise sealed to withstand the internal pressures created during the filtration cycle. As the sludge is forced through the system, the water passes through the filter medium and is discharged through the filtrate port while the solids become trapped within the spaces, forming a dewatered cake against the filter medium. When the cycle is over, the plates are separated and the dewatered cake is released into a collection bin. The operator often has to remove the cake from the filter medium manually. Filter presses are usually able to achieve a drier filter cake than rotary drum filters and do not require precoating with a filter aid. The filtrate that results from either of these operations is usually piped back to the beginning of the treatment system or is simply discharged with the effluent water. Figure 8-9 presents a diagram of a filter press.

Industry Application

Thirty-one percent of the in-scope industrial laundry facilities responding to the detailed questionnaire (59 of 193) reported dewatering their sludge before disposal. The types of dewatering devices reported include:

Plate and frame filters	34 facilities (58%)
Rotary vacuum filters	16 facilities (27%)
Sludge dryers	4 facilities (7%)
Bag filters	2 facilities (5%)
Other	2 facilities (5%)

In the industrial laundries industry, most of the sludge that is dewatered comes from DAF or chemical precipitation units. Nearly half of the dewatering devices (28 of 59 facilities) process sludge from a DAF unit. Fifteen dewatering devices process sludge from a chemical precipitation unit. The remaining dewatering devices process sludge from other sources.

Characteristics of industrial laundry sludge are highly dependent on the items washed, water conditions, and upstream treatment. Facilities responding to the detailed questionnaire that generate sludge reported an average solids content of 16 percent for the underwatered sludge. Facilities that dewater a sludge reported an average solids content of 62 percent for the dewatered sludge.

Twenty-nine percent of facilities that dewater sludge add one or more chemicals that aid in dewatering. The chemicals commonly added to aid in industrial laundry sludge dewatering are:

Chemical Added	Number of Facilities
Lime	13 (45%)
Polymer	10 (34%)
Diatomaceous earth	5 (17%)
Perlite	5 (17%)
Ferric chloride	4 (14%)

Note that facilities that add more than one chemical are represented twice in the above table.

8.5.9 pH Adjustment

General Description

Because many treatment technologies used in the industrial laundries industry are sensitive to pH fluctuations, pH adjustment may be required as part of an effective treatment system. In addition, the pH of the final effluent from these technologies must often be adjusted prior to discharge to meet POTW regulatory limits. A pH adjustment system normally consists of a small tank in which the wastewater pH is adjusted by chemical addition controlled by a pH meter and mixing. To adjust the pH of the wastewater, either caustics or acids are added to the mixing tank. Some treatment technologies require a high pH (e.g., chemical precipitation), while others require a low pH (e.g., chemical emulsion breaking).

Industry Application

Twenty-two percent of in-scope facilities responding to the detailed questionnaire (42 of 193) reported treating their wastewater with pH adjustment. Several industrial laundries reported operating more than one pH adjustment unit. Therefore, the facilities responding to the questionnaire reported operating a total of 47 pH adjustment units. Acid (usually sulfuric) is added to the pH adjustment unit most frequently (42 of 47). However, sodium hydroxide (4 of 47), and lime (2 of 47) are also added to the pH adjustment units. Sixty-eight percent of the pH adjustment units discussed in the detailed questionnaire (32 of 47) have one or more mixers. The average residence time of all 47 units at the 42 facilities is 2.1 hours.

8.5.10 Ultrafiltration/Microfiltration

General Description

Ultrafiltration and microfiltration use semipermeable polymeric membranes to separate emulsified or colloidal materials suspended in the process wastewater stream by pressurizing the wastewater so that it permeates the membrane. The membrane of an ultrafilter or a microfilter forms a screen that retains molecular particles based on their differences in size, shape, and chemical structure. The membrane allows solvents and lower molecular weight molecules to pass through.

In an ultrafiltration or microfiltration process, the wastewater is pumped through the membrane. Water and some low-molecular-weight materials pass through the membrane under the applied pressure (e.g., 10 to 100 psig). Emulsified oil droplets and suspended particles are retained, concentrated, and removed continuously (8). Ultrafiltration and microfiltration have the benefit of removing entrained solids and oils from wastewater with lower capital costs than chemical treatment (10). However, the limitations of the technologies include fairly narrow optimum operating conditions in terms of pH and temperature. In addition, if the wastewater has a high concentration of suspended solids, the wastewater will require substantial pretreatment to remove the solids to avoid excessive clogging of the membrane and increased maintenance costs.

Industry Application

One facility responding to the detailed questionnaire reported operating an ultrafiltration unit and one facility reported operating a microfiltration unit (one percent total). EPA has since contacted these facilities to determine the effectiveness of ultrafiltration/ microfiltration in treating industrial laundry wastewater. At the facility reporting use of the ultrafiltration unit, facility personnel reported that the ultrafiltration unit effectively treats wastewater generated at the facility. The filter membrane was recently changed out after 4.5 years of operation. Facility personnel did not report difficulties with membrane clogging. The wastewater from the facility is treated with a screen and pH adjustment prior to the ultrafiltration unit. At the facility reporting use of the microfiltration unit, facility personnel reported that they have since discontinued use of the microfiltration unit because the microfilter clogged whenever wastewater containing high levels of oil and grease was treated. Because of this clogging, the facility could not attain the required flow rate through the microfiltration unit.

8.5.11 Centrifugation

General Description

Centrifugation applies centrifugal forces to settle and separate higher density solids from process wastewater. The two most common types of centrifuges are the solid bowl decanter and the basket-type centrifuge. The solid bowl decanter consists of a long bowl, mounted horizontally and tapered at one end. The sludge or wastewater is introduced at one end continuously while the bowl rotates, and solids concentrate on the inner wall of the bowl as a result of the centrifugal forces caused by the bowl’s rotation. A helical scroll, spinning at a slightly different speed, moves the accumulated sludge toward the tapered end. The sludge is then discharged. The basket centrifuge operates on a batch basis. The sludge or wastewater is introduced into a vertically mounted spinning bowl. The solids accumulate against the wall of the bowl and the water is decanted by being forced over the bowl's outer lip. When the bowl has reached its capacity in solids collection, the spinning is stopped and a scraper is used to remove the solids. The basket-type centrifuge is well suited for sludges containing fine solids that are difficult to filter or where the nature of the solids varies widely (2).

Centrifugation may be combined with certain wastewater treatment chemicals that act to bring additional pollutants out of solution and form an insoluble floc (e.g., as in chemical precipitation) that is also separated by the centrifugal forces.

Industry Application

Two percent of in-scope industrial laundries responding to the detailed questionnaire (4 of 193) reported treating their wastewater with centrifugation. While only three of the four facilities reported removing sludge generated during centrifugation, EPA believes that all facilities treating their wastewater with centrifugation remove the sludge generated.

8.5.12 Volatile Organic Compound (VOC) Removal Technologies

General Description

In-Process Volatile Organic Compound (VOC) Removal

Two in-process VOC removal technologies were investigated for the industrial laundries industry: dry cleaning and steam tumbling. Both dry cleaning and steam tumbling effectively remove VOCs from laundry items prior to water washing, thereby reducing the introduction of VOCs into industrial laundry wastewater. Dry cleaning involves cleaning soiled items with an organic-based solvent that removes VOCs as well as heavy organic pollutants (e.g., oil and grease). These pollutants are recovered from the solvent through distillation and are then disposed. The distilled solvent may be then reused in subsequent dry-cleaning processes. In steam tumbling, soiled items are agitated within a modified washer/extractor while steam is injected into the chamber. The tumbling items contact the steam, which removes the VOCs. The steam is condensed, and the pollutants are recovered through a phase separation and disposed.

End-Of-Pipe VOC Removal

Two methods of removing VOCs from process wastewater that have been demonstrated in the industrial laundries industry are carbon adsorption and air stripping. Carbon adsorption uses activated carbon to remove dissolved VOCs from process wastewater. Activated carbon consists of an amorphous form of carbon that has been specifically treated with an oxidizing gas to form a highly porous structure having a large internal surface area. Granulated forms of this carbon are often used in a fixed-bed column. The wastewater is admitted into the unit from the top and is allowed to flow downward though a bed of the granulated activated carbon that is held in place within the column. As the water comes in contact with the activated carbon, the dissolved VOCs adsorb onto the surface of the activated carbon. Figure 8-10 presents a diagram of a fixed-bed activated carbon adsorption column.

As the activated carbon becomes increasingly saturated with VOCs, the effectiveness of the unit decreases and the carbon must be regenerated. In this process, the spent activated carbon is oxidized which removes the adsorbed VOCs from the surfaces. This process may destroy some of the activated carbon and decrease the performance of the rest. Therefore, the activated carbon must be periodically replaced for the adsorption unit to continue to operate effectively.

To maximize the performance and life of the activated carbon bed, all materials contained in the wastewater (e.g., suspended particles and heavy organics) that may foul the bed by “clogging” the pores of the carbon particles must be removed prior to this treatment process. In addition, the performance of the units may be improved by periodically backflushing the units. Fixed-bed carbon adsorption units may be operated singly, in series, or in parallel.

Air stripping is usually performed in a countercurrent, packed tower or tray tower column. The wastewater is introduced at the top of the column and allowed to flow downward through the packing material or trays. Air is simultaneously introduced at the bottom of the column and blows upward through the water stream. Volatile organics are stripped from the water stream, transferred to the air stream, and carried out of the top of the column with the air. The treated water is discharged out of the bottom of the column. Because the air stream now contains the VOCs, an air emission control device (e.g., a carbon adsorption unit) may be required to remove the VOCs before the air is released to the atmosphere.

Industry Application

<u>In-Process Volatile Organic Compound (VOC) Removal</u>

Two of the 193 in-scope industrial laundries responding to the detailed questionnaire (one percent) reported steam tumbling items before water-washing and five of the 193 facilities (three percent) reported dry cleaning items before water-washing.

<u>End-Of-Pipe VOC Removal</u>

Three of the 193 in-scope industrial laundries responding to the detailed questionnaire (2 percent) reported operating air strippers to remove VOCs from their process wastewater. However, EPA is aware that one of these facilities does not operate their air stripper. Two of the 193 industrial laundries (one percent) reported operating activated carbon adsorption columns to remove VOCs from their process wastewater.

8.5.13 Oil/Water Separation

General Description

Like chemical emulsion breaking units, oil/water separators are used primarily to remove oil and grease, as well as other related pollutants, from process wastewater streams. Oil/water separators are similar to batch chemical emulsion breaking units except that no chemical are added to an oil/water separator to enhance separation.

During oil/water separation, the wastewater is allowed to stand long enough to allow the oil droplets, having a lower specific gravity, to rise and form a layer on the surface. This layer may be removed by controlling the water level within the unit, such that the oil layer is raised above the weir and overflows into the collection unit while water underflows the weir. The oil layer may also be removed by manually or mechanically raking the surface over a weir with a skimming device.

Skimming devices typically work by continuously contacting the oil with a material, usually an oleophilic belt or rope, onto which the oil readily adheres. As the material passes through the oil layer, the oil coats the surface of the material. The oil-coated material then passes through a mechanism that scrapes the oil from the material into an oil-collection unit. This process uses a motorized drive to continuously remove oil from the wastewater surface. The skimming device shown in Figure 8-3 is similar to the type of skimming device used in oil/water separators.

Industry Application

Fifteen percent of industrial laundries responding to the detailed questionnaire (28 of 193) report treating their wastewater through oil/water separation. These facilities employ various devices to remove the oil that has risen to the surface of the wastewater. These include:

- Oil skimmer (64 percent);
- Oil mop (14 percent);
- Coalescer (11 percent);
- Gravity (7 percent); and
- Decanter (4 percent).

The average residence time of the wastewater in the oil/water separation units is 9.5 hours.

8.5.14 Media Filtration

General Description

Media filtration is used primarily to remove suspended solids from process wastewater streams. During the filtration process, wastewater flows through a filter medium causing solids suspended in the water to become trapped in the medium. Filter media are usually beds of granular particles such as sand, anthracite, garnet, or carbon. The speed that the wastewater flows through the filter medium controls the size and number of suspended particles removed from the wastewater stream. To control the wastewater flow rate through the filter medium, the wastewater may flow horizontally or vertically through the filter bed, or the wastewater may be pumped under pressure through the filter bed.

As wastewater flows through the filter medium, suspended solids removed from the wastewater become trapped in the interstitial spaces between the granular particles of the filter bed. Over time, this may cause the filter medium to become clogged. Therefore, some media filtration units may be periodically backwashed to unclog the filter medium.

Industry Application

Ten of the 193 in-scope industrial laundries responding to the detailed questionnaire (19 percent) reported operating a media filtration unit. Two of these facilities reported operating two media filtration units, resulting in 12 total media filtration units operated by the in-scope industrial laundries responding to the detailed questionnaire. Sand was the most commonly filter medium reported (7 of 12, 58 percent). Five media filtration units used sand alone (42 percent); two media filtration units operated with sand, anthracite, and garnet as the filter media (17 percent). Seventeen percent of the media filtration units (2 of 12) used cloth as the filter medium. One media filtration unit operated with carbon as the filter medium. Another media filtration unit operated with clay as the medium. The final media filtration unit operated with metal filings as the medium. Ninety-two percent of the media filtration units (11 of 12) operate under pressure. Eight media filtration units are periodically backwashed to prevent clogging of the filter media. All seven sand media filtration units and the metal filings media filtration unit are periodically backwashed. Facilities operating media filtration with backwash reported an average backwash cycle of 10 minutes, which occurs an average of 3 times per day.

8.6 Pollution Disposal Practices in the Industrial Laundries Industry

As established in the environmental management hierarchy, pollution disposal or release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner. All 193 in-scope industrial laundries responding to the detailed questionnaire reported discharging their wastewater to a publicly-owned treatment works (POTW), a privately-owned treatment works (PrOTW), a federally-owned treatment works (FOTW), or a centralized treatment works (CTW). Three percent of the facilities discharging wastewater (5 of 193) also reported discharging a portion of their wastewater to land application.

Thirteen percent of these industrial laundries (25 of 193) reported having a portion of their process wastewater contract-hauled off-site for disposal. Facilities contract-hauling a portion of their wastewater off-site store the wastewater to be contract-hauled in above ground storage tanks so that the water can be hauled off-site in bulk. Wastewater is typically hauled off-site in 5,000 gallon increments, which is the capacity of most vacuum tankers used to haul the wastewater. The frequency of bulk wastewater pickups depends on the amount of time required to generate 5,000 gallons of wastewater. The wastewater, handled as non-hazardous waste, may be hauled off-site for treatment to a Treatment Storage Disposal Facility (TSDF) or to a Centralized Waste Treater (CWT) (11). Facilities having only a portion of their wastewater hauled off-site also have stream splitting capability as discussed in Section 8.5.2 of this document.

8.7 References

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